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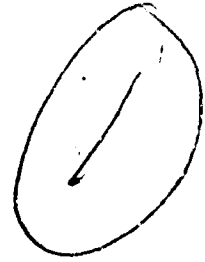
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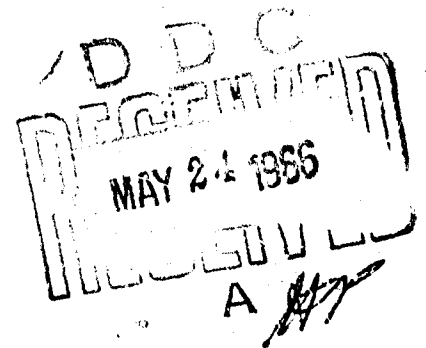
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Pres (F)

FINAL REPORT on

TAC MISSION ~~FF~~ FF 857,

# AIR COMBAT TACTICS EVALUATION

F-100 F-104 F-105 F-4C

Vs

MIG-15/17 TYPE A/C (F-86H) (u) (8)

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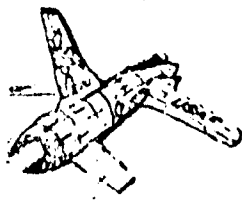
(10) James C. Hare; Michael S. Muskat  
is Jake D. Williams.

(11) 17 Jun 65,

(12) 153 p.

11 JUN 1965

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## FOREWORD

TAC directed the USAF Fighter Weapons School, Nellis AFB, Nevada, to conduct an evaluation to determine the most suitable offensive and defensive maneuvers for the F-100, F-104, F-105 and F-4C versus MIG 15/17 type aircraft.

Colonel James C. Hare, Commandant, Fighter Weapons School, was designated project officer. Authority for the conduct of the test was TAC message C-0054, 28 April 1965 (SECRET). This report is submitted in accordance with TACR 80-1.

Assistant project officers were designated for each type of participating aircraft. F-86H, F-104 and F-4C team commanders were so designated for their respective types of aircraft.

F-86H	-	Lt Col Joseph J. Maisch, Jr. 175 TFG, Md ANG
F-100D	-	Capt Zeke D. Williams USAF FWS
F-104C	-	Capt Philip E. Smith 479 TFW, George AFB, Calif
F-105D	-	Capt Michael S. Muskat USAF FWS
F-4C	-	Lt Col Ralph S. Parr, Jr. 4453 CCTW, Davis Monthan AFB, Ariz

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FINAL REPORT

AIR COMBAT TACTICS EVALUATION

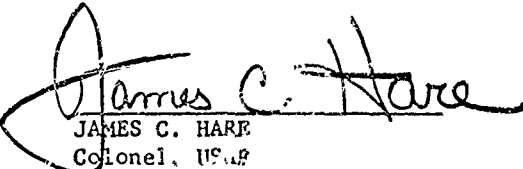
TAC MISSION FF-857

26 APR - 7 MAY 1965


This report was prepared by personnel of the USAF Fighter Weapons School, Nellis AFB, Nevada. Comments should be directed to Hq Tactical Air Command (DO) with info to USAF FWS.

Report prepared by:

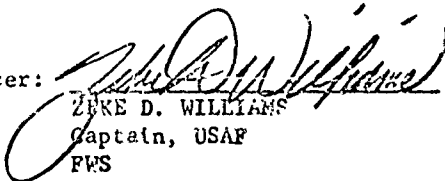
Project Officer:

  
JAMES C. HARE  
Colonel, USAF  
Commandant, FWS

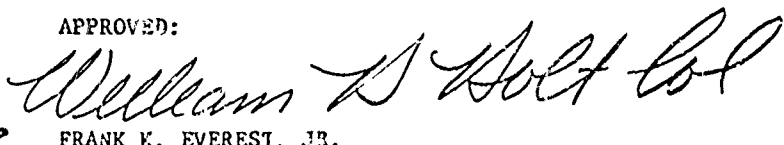
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Asst Project Officer:

  
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Captain, USAF  
FWS

APPROVED:

*for*   
FRANK K. EVEREST, JR.  
Colonel, USAF  
Commander, 4520 CCTW

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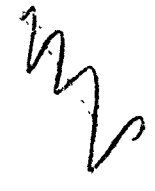
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ABSTRACT

The objectives of the Evaluation (TAC Mission FF-857) were to determine the most suitable offensive and defensive maneuvers for the F-100, F-104, F-105 and F-4C versus MIG 15/17 type aircraft. Energy maneuverability diagrams were used to substantiate conclusions and recommendations. Use of energy maneuverability concept for planning was limited; however, because necessary energy maneuverability diagrams were not available for the F-86H aircraft, which simulated the MIG 15/ MIG 17 types.

It was determined that the F-100, F-104, F-105 and F-4C should avoid co-speed, high angle of attack engagements with the MIG 15/17 type aircraft. On the offensive, a speed advantage should be maintained. On the defensive, maneuvering in an attempt to cause an overshoot will probably be unsuccessful. Therefore, an attempt to disengage should be made by reducing the angle of attack and using max power to move out of the attacker's range, maneuvering as necessary to spoil a tracking solution until well outside gun and/or missile range.

Performance data obtained in this test is in agreement with data obtained from energy maneuverability diagrams.



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1. INTRODUCTION: In Southeast Asia our supersonic F-100s, F-105s and F-4s have engaged or been engaged by subsonic MIG 15s and MIG 17s.

The results of these engagements indicate an urgent need to determine the most suitable offensive and defensive maneuvers to be employed against the MIG 15/17s. The F-100, F-104, F-105 and F-4C were evaluated in simulated air-to-air combat using the F-86H as MIG 15/17 comparable aircraft.

2. DESCRIPTION OF TEST ITEMS: Refer to flight handbooks for information on the following types of aircraft used in the test.

- a. Three F-100Ds provided by the 4520th CCR Tng Wg.
- b. Three F-104Cs provided by the 479th Tac Ftr Wg.
- c. Five F-105D/Fs provided by the 4520th CCR Tng Wg.
- d. Three F-4Cs provided by the 4453rd CCR Tng Wg.
- e. Five F-86Hs provided by the Maryland and the New York Air National Guard.

For purposes of the evaluation, all aircraft were considered to be equipped with 20mm cannon, either M-39 or M-61, and with AIM-9/R missiles. This assumption was made in view of pending F-4C gun installation.

3. PURPOSE OF TEST: To determine the best offensive and defensive maneuvers to be employed against MIG 15/17 type aircraft and to verify through flight test certain data and conclusions obtained from energy maneuverability diagrams.

4. OBJECTIVES OF TEST: The objectives of this evaluation were to determine the following:

- a. Most suitable offensive maneuvers.

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- b. Most suitable defensive maneuvers.
- c. Most suitable element tactics.
- d. Verify certain energy maneuverability data.

### 5. CONCLUSIONS:

#### a. General:

(1) If F-100, F-104, F-105 or F-4C cruising at .9 mach or below are engaged by MIG 15/17 type aircraft, executing .95 mach attacks from the rear hemisphere, the best course of action is to employ a maximum power acceleration to supersonic speed for separation rather than employing defensive maneuvers designed to force an overshoot.

(2) If such attacks are detected within minimum separation range (3000-4000' for F-4C, 4000-5000' for F-104, 5000-7000' for F-100 and F-105), an accelerating diving spiral, max power escape is recommended.

(3) If such attacks are detected at attacker gun fire range, a break followed immediately by the diving spiral must be attempted.

(4) For offensive use during a maneuvering fight, the AIM-9/B is severely limited in that the launch capability is restricted by low angle off and G limitations.

(5) Evaluation of TAC fighter maneuvering flight capabilities at low altitude (2000'-15,000') was not analyzed due to the imposed 10,000' AGL minimum altitude restriction. Such capability is predicted by current energy maneuverability data to be greater than at higher altitudes.

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(6) According to participating F-4C aircrews, opportunities were presented for employment of AIM-7 and particularly AIM-7E missiles; however, live testing against maneuvering targets is required immediately to verify predicted capabilities.

### b. F-100D:

(1) Defensive employment of descending hard turns is recommended to defeat AIM-9B type missile attacks. F-100 mach should be maintained at .9 or higher.

(2) Defensive employment of breaks is recommended to defeat gun attacks detected within or slightly outside gun firing range. Breaks should be continued to a diving separation maneuver if an offensive position is not achieved by a break maneuver.

(3) Use of high G rolls or scissors maneuvers to gain an offensive position is not recommended against F-86H type aircraft.

(4) F-100 attacks should be initiated with a high energy level (approximately mach 1) to enable closure to firing range prior to excessive speed loss in attempting to track defending F-86H type aircraft through turns. The  $\frac{1}{2}$  roll away and down is normally the best disengagement method following such attack.

### c. F-104C and F-4C:

(1) Defensive employment of descending hard turns is recommended to defeat AIM-9/B type missile attacks. Mach number of approximately .9 or higher should be maintained.

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(2) Defensive employment of breaks is recommended to defeat gun attacks detected within or slightly outside gun fire range. Breaks should be continued to a diving separation maneuver if an offensive position is not achieved.

(3) Use of high G rolls or scissors maneuvers to gain an offensive position is not recommended against F-86H type aircraft.

(4) F-104 and F-4C attacks should be initiated at a high energy level (1.2 mach or higher) to enable closure prior to excessive loss of airspeed in attempting to track defending F-86 type aircraft through turns. The  $\frac{1}{2}$  roll away and down is the best disengagement method following such attack.

(5) If a gun attack is detected at approximately 4000' or greater range, a 0 to 1C max power dive for separation employing sporadic rolling maneuvers is recommended.

### d. F-105D:

(1) Defensive employment of descending hard turns is recommended to defeat AIM-9/B type missile attacks. F-105 mach should be maintained at .9 or better to conserve maneuvering potential.

(2) Defensive employment of breaks is recommended to defeat gun attacks detected within or slightly outside of gun fire range. Breaks should be continued immediately to a diving spiral separation maneuver if not successful in forcing overshoot.

(3) Use of high G rolls over or scissors maneuvers to force overshoot and regain the offensive is not recommended against F-86H type aircraft. The use of a high G roll under will result in an

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attacker overshoot 3000-5000' above the defender, but leaves the F-105 with little maneuvering potential.

(4) F-105 attacks should be initiated with a high energy level (1.2 - 1.3 mach) to enable closure to firing range prior to excessive speed loss in attempting to track defending F-86 type aircraft through turns. The  $\frac{1}{2}$  roll away and down is the best disengagement method following such attack.

6. RECOMMENDATIONS: The following actions are recommended:

a. Tactical fighter aircrews be provided the information in this report on an expeditious basis.

b. Tactical formations be utilized by TAC fighter flights that emphasize good lookout capability and mutual coverage, due to the necessity, as determined by this evaluation, to detect enemy MIG 15/17 type aircraft attacks at sufficient distance to gain separation and then re-engage at higher mach.

c. Fighter pilots and commanders should not consider ACT maneuvering obsolete as a result of this evaluation. The conclusions that accelerating separation maneuvers offer the best course of action is valid only against mach limited enemy fighters. Such maneuvers may not be possible if TAC fighters are attacked by MIG-21 or later type Soviet aircraft and a resort to overshoot forcing defensive maneuvers may be necessary.

d. To increase proficiency in flying widely spread tactical formations, the use during training of "route" formation should be minimized and maximum use be made of tactical formations.

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e. Realistic wing level Air Combat Tactics training programs should be conducted, to include flying clean aircraft, and to include minimum restriction on maneuvering other than flight handbook limitations.

f. In future procurement of air superiority fighters, consideration should be given to the desirability of high positive energy rate values while under G load (see Annex G). Without this characteristic, speed and altitude loss during high G maneuvering is rapid.

### 7. DEFICIENCIES:

a. Rearward lookout capability in F-105 and F-4C was found to be severely restricted. The presence of cockpit mirrors did not alleviate the problem.

b. AIM-9/B launch parameters of launch aircraft G load and angle off severely restrict the use of this missile in a maneuvering flight.

c. Specific F-4C deficiencies are as listed in Annex E, F-4C Team Summary.

### 8. TEST ENVIRONMENT AND PROCEDURES:

#### a. Test Environment:

(1) This evaluation was conducted by Tactics Development Division and Operations and Training Division, USAF Fighter Weapons School, Nellis AFB, Nevada.

(2) All physical testing was conducted in FAA Special Operating Areas within the Nellis local flying area from flight level 240 to 410, and in the underlying local flying area from 10,000' AGL to flight level 230.

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(3) Sorties were flown employing the F-86H versus F-100D, F-104C, F-105 and F-4C aircraft.

(4) All sorties were flown in a clean configuration with full internal fuel.

(5) Recovery distance was 60-100 NM, with normal initial approach fuel at "homeplate," with limited alternate allowance. Missions averaged 40-50 minutes in duration with sufficient fuel for 2 to 4 engagements totaling 20-30 minutes. Optimum return cruise and idle power descents were used frequently.

(6) The experience level of the majority of the 26 participating pilots was high, both in terms of jet and unit equipped aircraft, as indicated in Annex C.

### b. Procedures:

(1) Emphasis was placed on one versus one sorties (one F-86H vs one F-100, one F-86H vs one F-105, etc.), to evaluate all appropriate offensive and defensive maneuvers. An attacker and defender were designated on each flight to provide equal sampling of offensive and defensive maneuvers. Initial engagement conditions were prebriefed to simulate either combat air patrol (.85 - .95 mach at 30 - 35M' depending on type aircraft) or low altitude approach to ground target (300 - 330 KCAS at 20M').

(2) Two missions of two-versus-two were scheduled for each TAC fighter to evaluate element tactics. TAC fighters were designated attackers on one two-versus-two mission and as defenders on the other.

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(3) Participants were briefed to obtain data on sustained "G" capability at various mach numbers and at 15M and 35M feet to verify energy maneuverability PsV diagrams.

(4) Test data cards were compiled during flight and in flight debriefing (see Annex B). The cards were then turned in to a project officer to be used in preparing the final report.

(a) Description of Test Data Cards (see Annex B):

1 Test Data 1 Card was used on ACT-1 (Air Combat Tactics 1), ACT-2, and ACT-X. On all ACT-1 flights the F-86H was designated the attacker and the TAC fighter was designated the defender. The F-86H was given an initial advantage of speed, altitude and position. As the F-86 closed for a gun attack, the defender countered with a prebriefed defensive maneuver, i.e., break, hard turn, scissors, high "G" barrel roll, etc. Engagements were terminated after desired evaluation of maneuvers was made. ACT-2 was identical to ACT-1 with the exception that the F-86 assumed an initial defensive role and the TAC fighter assumed an offensive role. ACT-X was used to repeat portions of ACT-1 or ACT-2 as deemed necessary for evaluation.

2 Test Data 2 Card (was used on ACT-3 and ACT-4 and ACT-X). This card is basically the same as Test Data 1 Card except both aircraft were equipped (simulated) with AIM-9/Bs in addition to guns. The attacker initially attempted to position for a missile launch, but once the missile attack was nullified a follow-up gun attack was attempted. On ACT-3, the F-86H was the attacker with the TAC fighter defending. The roles were reversed on ACT-4. ACT-X was used to repeat any portions of ACT-3 and ACT-4 deemed necessary for the evaluation.



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3 Test Data 3 Card was used on ACT-5, ACT-6 and ACT-X, to collect data on element tactics (2 vs 2). On ACT-5 the F-86H assumed the attacker roles, with the TAC fighters defending. The roles were switches on ACT-6. ACT-X was used to repeat portions of ACT-5 and ACT-6 as deemed necessary for the evaluation. Defensive splits, offensive counters to the split and the ability to lend mutual support were to be evaluated.

(5) Immediately following the evaluation, team leaders of the participating visiting teams (F-86H, F-4C and F-104) were asked to record their comments and conclusions for inclusion in this report. Although specific conclusions in some cases differ from those in this report, the team summaries are included in Annex E in an attempt to portray the diversity of thought on the subject of air combat tactics, and counter any possible bias on the part of the project officers.

9. TEST RESULTS AND DISCUSSION:

a. General: Although there are considerable differences in performance capabilities of the TAC fighters evaluated, they all share the same basic advantages and disadvantages when compared to an F-86H type aircraft. The F-100, F-104, F-105 and F-4C all have an advantage in top speed, all have a sustained G advantage at high mach numbers, and all have a disadvantage in sustained G at low mach numbers. When these facts are known, certain conclusions are obvious.

- (1) Take advantage of the superior speed of the TAC fighters.
- (2) Don't slow down and turn with F-86H type aircraft.
- (3) Employ "hit and run" tactics.

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Results of this evaluation strongly support these foregone conclusions. During the evaluation the following results were identified. It must be emphasized that the missions flown during this test were not "hassles" or "rat races". Prebriefed maneuvers were flown and evaluated, even though in some cases these maneuvers were known to be ineffective or foolhardy. In other words, the TAC fighters did not just play their game, but, for the purpose of this evaluation, slowed down and played the F-86's game.

A discussion of each of the TAC fighters versus the F-86H follows. First, defensive situations will be covered, analyzing effective and ineffective defensive courses of action. At the start of each engagement the TAC fighter defender used a relatively low mach number to allow the F-86H to close and although the attack was detected, did not attempt escape until the prebriefed defensive maneuver initiation range was reached by the attacker. Second, offensive situations will be discussed, covering not only how, but how not to maneuver on the offensive.

b. F-100 vs F-86H:

(1) F-100 Defender, F-86H Attacker:

(a) Maneuvering against a missile attack: A typical defensive engagement began with the F-86H at 5-7 o'clock high and approaching missile range. Assuming the attack was detected prior to launch, a hard turn into the attack placed the attacker outside the missile launch envelope. During this evaluation it was difficult to analyze maneuvering against a missile attack, because of the pilot's inability to judge angle-off, range, and rate of closure. It was

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considered, however, that a three-"G" turn into the attack would nullify the missile attack by placing the attacker outside angle-off launch parameters. As the attacker's range decreased, the 2 "G" launch limit was exceeded. Once the attacker gave up on the missile attack, a follow-up gun attack was initiated.

(b) Maneuvering against a gun attack: In maneuvering against a gun attack, the defender had two basic options:

1 Turn, in an attempt to cause an overshoot and subsequently gain an offensive position.

2 Out run the attacker and move outside gun/missile range.

When the turn option was selected, the F-100 played the turn with respect to the attacker's relative position. Max performance turning was approached only when the attacker closed to gun range. A mistake frequently made was to go to max performance maneuvering too soon, consequently losing airspeed and future maneuvering capability, placing the defender in a more vulnerable position. If max performance is achieved at the proper time (attacker inside gun range), and the attacker presses the attack in the plane of the defender's turn, a very rapid overshoot will occur and the attacker will slide out front. The reason this occurs is that at High "G" loads the F-100 loses airspeed so much faster than the F-36H type aircraft. In a hard turn, the F-100 airspeed can go from 300K to 140K in 90-120° of turn. Naturally the F-86 loses airspeed, also, but not nearly as rapidly.

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If the F-86 employed the high speed yo-yo he effectively countered the F-100's turn and maintained an offensive position. The F-86 pilot, recognizing an imminent overshoot, learned to discontinue the pass and pull up into the vertical plane. The F-86 attack normally had to be discontinued at extreme gun ranges (approximately 3500'). The exact range depended on angle-off and rate of closure. If the F-100 employed the hard turn properly, and forced the F-86 into a high speed yo-yo, the gun attack was only temporarily nullified. The F-86, following the yo-yo, was at six high, approximately co-speed. The turn required to force the yo-yo cost the F-100 most of his maneuvering airspeed. The F-86 was able to slide back down, or perform a roll-off back down to gun position. The F-100's subsequent defensive turn was completely ineffective because of its resulting loss of speed. If the F-100 took the fight down into the vertical plane, with the attacker at close range, an overshoot was more likely, since the attacker was less likely to employ the yo-yo type maneuver effectively. If an overshoot occurred, and the attacker had very little nose/tail separation, a vertical rolling scissors forced the F-86 into a 12 o'clock position. Reason: The F-100 was capable of achieving a very high angle-of-attack and lost energy (airspeed) faster than the F-86. If, on the overshoot, the F-86 had good nose/tail separation, it did not have to maneuver into a vertical rolling scissors. In those cases where the fight was going down and both aircraft had approximately 180K, the F-86 was able to roll wings level and zoom up into the vertical plane. If the F-100 attempted this, he was not able to match the attacker's rotation angle in the vertical plane. Therefore, the F-86 usually reached in the F-100's six o'clock

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high position, with the F-100 completely out of maneuvering airspeed. From this advantageous position, the F-86 was able to roll off into a gun position and achieve a gun kill. From this experience with the F-100's comparative turning capability, the obvious conclusion was: Don't try to turn with an F-86 type aircraft.

A second defensive option was also attempted, other than attempting to nullify missile/gun attack by turning. The second option was to use the F-100 speed advantage to move outside missile/gun range. Ideally all attacks would be detected outside missile/gun range, but for the purpose of this evaluation some attacks were allowed to reach closer ranges prior to defensive maneuvering. This was considered likely to occur at the lower speeds associated with ground attack missions, than at the higher speeds associated with combat air patrol. It was determined that if the F-100 pilot detected the attack outside missile/gun range, he should drop the nose and use AB as necessary to prevent the attacker from closing. The following courses of action were developed as a result of the evaluation: If the attacker is detected inside the missile envelope, the diving, max power separation is not feasible. If a three "G" defensive turn is initiated, the missile attack will be defeated, however, this will enable an F-86 type aircraft to cut off on the inside of turn and close. As his range is reduced, the F-100 must tighten the turn and eventually experience airspeed decay. To maneuver against a missile attack, a turn into the attack is necessary, however, the turn should be just hard enough to place the attacker outside the launch envelope. With only a .3 to .4 mach advantage, the F-100 will take an appreciable amount of time to move outside missile

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range, and any unnecessary turning will be to the attacker's advantage. If the attacker is equipped with gun only, an escape should still be attempted, initiated prior to the attacker reaching gun range. If the attacker is detected after reaching a gunfire position, a hard turn or break is advisable to spoil his tracking solution. This turn should be of short duration to prevent loss of airspeed. If the attacker overshoots, a reversal should be made, followed by a straightaway, max power, descending separation maneuver. If the attacker does not overshoot, a reversal, immediately followed by zero "G", frequently throws the attacker out of phase. If successful in placing the attacker out of phase, the F-100 has a few seconds of safe time in which to unload the wings (0 to 1G) and begin the separation maneuver. The defender should employ sporadic rolling or "S" type maneuvering to spoil a tracking solution until well outside gun range.

(2) F-100 Attacker, F-86H Defender:

(a) Maneuvering for a missile attack: When the attack was detected prior to launch the F-86 invariably nullified the attack with a defensive turn. In most cases the only chance for a successful launch appeared to be an undetected approach. A barrel-roll attack was effective in reducing angle-off, but if the defender maneuvered properly it was still impossible to reach the launch envelope, and a follow-up gun attack had to be initiated.

(b) Maneuvering for a gun attack: If the F-86 made a hard turn while the attacker was well outside gun range, a large angle-off resulted as the attacker approached gun range. Under these circumstances an overshoot was usually unavoidable. The resulting scissors

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maneuver then forced the F-100 out front. If the F-100 countered the overshoot with a high speed yo-yo, the F-86 effectively countered by pulling up into vertical plane, followed by a roll-off into the F-100's six o'clock position.

If the F-100 was allowed to reach gun range at a low angle-off an overshoot could be avoided, but at the expense of maneuvering airspeed. The F-86, out front, with an airspeed advantage, was able to pull up high into the vertical plane and roll in behind the F-100. The F-100, out of maneuvering airspeed, was an easy "kill".

To preclude the above situations from developing, the F-100 should employ "hit-and-run" tactics. A high mach number should be maintained at all times in a maneuvering fight. The exact minimum mach will vary with the attack conditions (defender's mach, altitude, etc.). A general rule of thumb is: Never slow down below best AB climb speed ( 92 true mach). If the defender counters properly, the attack will have to be discontinued at extreme gun range, or airspeed will be sacrificed. To break off the attack, reverse down and away from the defender and maneuver for separation.

(c) Two F-100s vs two F-86s (Element Tactics): Resources allowed only one partially effective mission to be flown and a meaningful evaluation could not be made. See Annex B, Card #67.

c. F-104C vs F-86H: The following results were identified:

(1) ACT-1: Thirteen .86 to .96 mach stern quarter gun attacks were completed by F-86H aircraft against F-104C aircraft. Of these attacks, seven were accomplished with the F-104 positioned at 35,000' at .85 - .9 mach, and six with the F-104 at 325-350 KIAS at 20,000-

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21,000'. Eight of these attacks resulted in F-86H gun kill assessment. F-104 hard turns and breaks were unsuccessful and the maneuvers were followed by the F-86H. The F-104 positive G accelerating diving spiral was successful in effecting five escapes; however, if the F-104 pulled up following diving escape, the F-86 could close the distance for a gun tracking position. In no case did the F-104 force an overshoot and regain the offensive.

(2) ACT-2: During 12 passes by F-104 aircraft against F-86H defenders, gun kills were assessed for the F-104 on six. In all cases the F-86H could force an F-104 overshoot, once it started a hard turn or break; however, on more than half of the passes the defending F-86 pilot had difficulty detecting the F-104 attack although he knew when and from where it was coming. Even when the attack was detected, defenders over estimated F-104 range due to its small size and delayed breaking until too late.

(3) ACT-3: During 16 F-86H .9 - .95 mach missile/gun stern quarter attacks, F-86 gun kills were assessed on 10 attacks. Again, F-104 level turns, breaks the hard pull ups were not effective. The diving spiral escape maneuver, if executed with a rapid roll entry, was effective in enabling F-104 escape. Only three opportunities occurred for possible AIM-9/B launch by F-86 aircraft following F-104 defensive maneuver initiation.

(4) ACT-4: During 11 F-104C .9 to 1.2 mach stern quarter missile/gun attacks, no gun kills were achieved due to F-86 forcing overshoot in all cases prior to gun range. (Malfunctioning F-104



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stick kicker onset at 2G degraded F-104 capability on four passes.)  
In one F-104 gained a missile launch position using a barrel roll attack.

(5) ACT-5: During three element attacks by F-86H aircraft against a defending F-104 element, none of the attacks resulted in a sandwich by the defenders. The conclusion reached was that diving spiral separation was the better course of action for F-104 aircraft rather than attempt defensive split mutual support.

(6) ACT-6: During each of two element attacks by F-104 aircraft, gun kills were achieved on one F-86 defender due to loss of visual contact by the defenders with at least one of the attacking F-104s. Offensive fluid separation was effectively employed by the F-104s.

(7) F-104C Summary: As with the F-105, if a rear hemisphere missile/gun attack by MIG 15/17 type aircraft is observed by defending F-104 aircraft, max acceleration 0-1G diving separation is recommended. If the attack is observed too close for this type of separation, a diving accelerating spiral employing rapid roll rates is effective. The F-104 has an excellent chance to subsequently re-engage undetected visually by the enemy. If the attacking threat is carrying missiles, the accelerating dive, if delayed until missile launch range, must rapidly generate angle-off prior to attempting escape.

(a) The F-104 has little success in forcing overshoots through the use of breaks, hard turns, high G rolls, or scissors maneuvers.

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(b) In attacking with the F-104, an outstanding advantage is its small frontal silhouette. The F-104 attack should be pressed at supersonic speed, 1.1 - 1.3 mach, to insure closure before the defender's turn forces an overshoot.

(c) Both in attacking and defending with the F-104, once supersonic separation has been effected, initiation of climb must be delayed at least 1-2 miles to prevent MIG 15/17 type aircraft from cutting off in the vertical plane.

d. F-105 vs F-86H: During the evaluation the following results were identified when the missions were analyzed. It must be emphasized that instead of merely attempting missile or gun kill, or attempting escape, the participants were deliberately testing the effectiveness of prebriefed maneuvers.

(1) ACT-1: Ten .92 - .97 mach stern quarter gun attacks were completed by F-86H aircraft against F-105D aircraft. Of these, seven were accomplished with the F-105 positioned at 33,000-35,000' at .9 mach simulating typical combat air patrol cruise conditions. Three were accomplished with the F-105 at 20,000-25,000' at 330 KCAS, simulating typical medium altitude bomb mission cruise conditions during approach to the target. Five of these attacks resulted in F-86H gun kill assessment with F-105s attempting hard turns, breaks, High G rolls under and High G rolls over. Three successful escapes by F-105 resulted from separation maneuvers (one accelerating, descending hard turn; one break, followed by an immediate "Split S" AB escape; and one roll under, and accelerating dive). In no case did the F-105 force sufficient overshoot to gain the offensive.

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(2) ACT-2: Ten stern quarter or 6 o'clock attacks were completed by F-105D/Fs against F-86H aircraft. Of these, six were accomplished with the F-86 positioned at 35,000' and .85 mach and four were flown against the F-86 positioned at 20,000' at speeds of 330 KCAS or .85 mach. F-105 attack speeds varied from .98 to 1.25 mach. During these attacks, the F-105 achieved one gun kill, with one probable and one possible. The F-86H was able to effect escape in nine cases and was able on three of these cases to score a kill on the departing F-105. Generally, the F-86 used a hard turn, followed by a break when the F-105 closed to gun range, and forced an overshoot. If the F-105 yo-yoed high, the F-86 was able to reverse and accomplish a roll off with a higher apex into the F-105's 6 o'clock position.

(3) ACT-3: Four stern attacks were completed at .9 - .95 mach by F-86H aircraft against F-105D aircraft positioned for two attacks at 35,000', .85 - .9 mach and for two attacks at 20,000-22,000', 330 KCAS. During these attacks, F-105D defensive maneuvering was initiated at typical terminal AIM-9/B launch conditions (i.e., 5000-7000' range, 0-15° angle-off, less than 2G on launch aircraft). The attacking F-86 attempted to obtain a subsequent AIM-9/B missile launch position (less than 15° angle-off, less than 2G, 5000' range) and a follow-up gun kill position. In one case a subsequent missile launch position was obtained during the F-105 diving afterburner (AB) escape, and in three cases gun kills were obtained during F-105 evasive maneuvers (hard turn and diving spiral entries). During two head on engagements, with the F-86H possessing an airspeed advantage, high and low speed yo-yo maneuvering in AB was attempted by the F-105D. In the first case the F-86 scored a

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gun kill, in the second case the F-105 executed a separation maneuver after the F-86 reached a high side position. In the one case where the F-105D escaped from an F-86 stern quarter attack, the maneuvers were a descending hard turn (to deny subsequent missile launch positions), followed by a break when the F-86 closed to gun range, and an immediate entry into an AB accelerating vertical diving spiral with low altitude recovery at .98 mach. In one case after initiating the diving spiral escape maneuver, the F-105 pulled up hard into the F-86 and forced an overshoot, but as the F-105 attempted to reverse into the vertical rolling scissors to gain the offensive, it snap rolled twice at 250-300 KCAS. Recovery was immediate when controls were released.

(4) ACT-4: Three stern quarter attacks were completed by F-105 aircraft at .98 to 1.3 mach. Two of these resulted in gun kill assessment against the defending F-86H. Three head on attacks were completed by F-105s having initial speed and/or altitude advantage. In no case was a kill position achieved before the attack terminated.

(5) ACT-5 and 6: One mission combining both ACT-5 (F-105 defenders) and ACT-6 (F-105 attackers) was flown using an element of F-105s versus an element of F-86s. With the F-105s defending and attempting a defensive split, the low defender was "killed" before the high defender could effect a sandwich. When the attackers observed the high defender sliding toward 6 o'clock, they performed a break upward into the high defender, forcing the high defender to roll under and separate. With the F-105s attacking, a low defender kill was accomplished before the high defender could effect a sandwich, however, the trailing attacker was "killed" by the high defender before the attackers could separate.

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(6) F-105 Summary: With the F-105 in the defending role, if an attack is observed in the rear hemisphere, separation is the best course of action against F-86H type aircraft possessing good subsonic sustained turning capability. If the attack is observed within AIM-9/B type missile range, perform an immediate hard descending turn to acquire a minimum of 30 to 40° angle-off, maintaining or acquiring .9 - .95 mach through use of afterburner, then unload G and separate at supersonic speed. If the attack is detected approaching gun range execute a max performance break followed by an immediate roll in the direction of turn to the inverted position and execute an AB diving spiral escape maneuver. The effort here is to defeat tracking by combining moderate G with roll. As .95 mach is acquired, relax G and level off for separation. Regardless of the speed acquired, the F-105 pilot must not initiate a climb shortly after disengagement, or F-86H type aircraft will cut off and regain a firing position. The above measures assume an aggressively pressed attack by qualified enemy pilots.

(a) In attempting separation in F-105 aircraft as with the F-100, if the attack is detected at longer ranges (7000'+) the best method is a 0-to-1G push over into a dive with afterburner power, as is the case for the F-104 and F-4C; however, the acceleration is much slower than these latter aircraft (see Annex D), hence, the diving spiral escape may be needed to buy time to effect successful separation.

(b) With the F-105D in an attack role, attempt an afterburner stern attack at 1.2 to 1.3 mach. If the attack is detected and is countered by a hard turn, attempt tracking down to .95 mach and execute any yo-yos well astern of the defenders. Break off the attack

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at .95 mach with a half roll opposite the direction of the defender's turn and accomplish separation. If the attack is pressed below .9 mach, a defender high G roll can compromise F-105 separation.

(c) The above analysis places the F-105 in a poor position in terms of Air Combat Tactics maneuvering capability and confirms the results of TAC Test 63-4 Phase II. This is considered true in view of the high energy loss (speed and altitude) during maneuvering at medium and high altitude, predicted by Energy Maneuverability Theory. The F-105 is in severe trouble if forced to defend in the 250-200 KCAS region, therefore, every effort should be made to avoid this region and to separate and re-engage at .95 or higher mach.

e. F-4C vs F-86H:

(1) F-4C defender - F-86H attacker:

(a) Maneuvering against a missile attack: The F-86 was allowed to enter missile range from the stern quarter prior to any defensive maneuver on the part of the F-4C. When missile range was attained, the F-4C countered by executing a 3 "G" turn which in effect negated all missile attacks. Level turns, diving turns and slight climbing turns all proved successful. High "G" breaks and other high "G" maneuvers were also successful against a missile attack, but left the F-4C extremely vulnerable against a follow-on gun attack. The most successful procedure to utilize to defeat a missile attack with a follow-up gun attack was to execute a 3 "G" diving turn into the attacker, apply max power and execute a diving spiral. This maneuver achieved angle-off from the missile as well as adequate lateral separation to preclude the gun attack.

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(b) Maneuvering against a gun attack: All gun attacks were initiated at 3,000-4,000' range from the stern quarter with approximately a .10 mach advantage on the part of the attacker. To defeat a gun attack presented a slightly different problem than encountered with missiles. Maneuvers such as hard turns, breaks, split S, and other attempts to cause the attacker to overshoot were generally unsuccessful against the F-86H. At the speeds and altitudes flown during this evaluation, it was obvious that the F-86H had a decided maneuvering advantage. Two basic principles evolved as outgrowths of ACT-1 and -2.

1 It is pointless to attempt to out-turn a MIG 15/17 type aircraft with the F-4C.

2 When attacked, the F-4C should immediately strive for separation and re-enter the fight on its own terms.

If an attacker is first observed within gun range and has a .10 mach advantage, it was concluded that regardless of the defensive maneuver, the attacker will continue to close. Any defensive maneuvers where high "G" loads were attempted decreased range considerably and increased the kill potential of the attacker, as his maneuvering capability exceeded that of the F-4 to a great degree.

It was determined that the basic aim of the F-4 was to immediately strive for separation from an attacker by the use of the excess power available. This proved successful against a highly maneuverable but mach-limited type aircraft such as the F-86H.

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The most consistently successful escape was achieved by unloading to 0 to 1/4 G and simultaneously advancing to max power. This resulted in a rapid acceleration to co-air speed during which time the attacker closed an additional 1000-1200'. F-4C acceleration then permitted rapid separation to well outside of effective gun range. While the attacker is in gun range, it is imperative that the defender make the attacker's tracking problem as difficult as possible. This can be accomplished by "jinking" (sporadic rolling and yawing at low G) until out of gun range. It was determined after discussions with the F-86 pilots that it was much more difficult to track the F-4C when viewed from astern than when observed from a position which affords a plan view of the aircraft in a hard turn.

10. MAINTENANCE RESULTS: During the evaluation participating aircraft flew a total of 124 sorties broken down as follows:

<u>Number of A/C</u>	<u>Type A/C</u>	<u>Dates</u>	<u>Sorties</u>
5	F-86H	26 Apr - 7 May 65	63
3	F-100	26 Apr - 30 Apr 65	14
5	F-105D/F	26 Apr - 30 Apr 65	13
3	F-104C	3 May - 7 May 65	18
3	F-4C	3 May - 7 May 65	16

In commission records of the F-104, F-4C and particularly the F-86H aircraft were especially noteworthy. Only two malfunctions contributed to loss of sortie effectiveness

a. F-86H - One engine shroud binding during shutdown following an ACT sortie, necessitating engine change.



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b. F-104C - One stick kicker malfunction, reducing maximum G capability on two sorties.

11. TRAINING REQUIREMENTS: Recommend the following:

a. Continued command emphasis on realistic ACT training with a minimum of restrictions imposed above normal flight handbook limits for applicable aircraft.

b. Dissemination of the results of this report to all TAC, PACAF, and USAFE fighter units.

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ANNEX A

MISSION SUMMARIES

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F-86H versus F-100D

TAC Mission FF-857 ACT Evaluation - Summary

<u>Card #</u>	<u>Mission</u>	<u>Date</u>	<u>Attacker</u>	<u>A/C #</u>	<u>Type</u>	<u>Defender</u>	<u>A/C #</u>	<u>Type</u>	<u>T.O. Time</u>	<u>Fly Time</u>
60	ACT-1	28 Apr	A	113	86	J	099	100	1300	0:45
61	ACT-1	29 Apr	F	294	86	J	099	100	0930	0:45
62	ACT-1	29 Apr	A	113	86	K	130	100	0930	0:45
63	ACT-2	29 Apr	J	099	100	E	738	86	1300	0:45
64	ACT-2	29 Apr	K	130	100	F	294	86	1300	0:40
65	ACT-3	30 Apr	F	294	86	I	099	100	0925	0:45
66	ACT-4	30 Apr	K	110	100	G	255	86	0940	0:45
67	ACT-5,6	30 Apr	F - G	294-255	86	I - K	110-099	100	1400	0:45

NOTE: Letters refer to "attacker" or "defender" pilot who flew the mission. See Annex C.

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F-86H versus F-104C

TAC Mission FF-857 - ACT Evaluation - Summary

<u>Card #</u>	<u>Mission</u>	<u>Date</u>	<u>Attacker</u>	<u>A/C #</u>	<u>Type</u>	<u>Defender</u>	<u>A/C #</u>	<u>Type</u>	<u>T.O. Time</u>	<u>Fly Time</u>
20	ACT-1	3 May	B	1255	86	R	891	104	0910	0:50
21	ACT-1	3 May	D	1294	86	S	892	104	0910	0:50
22	ACT-1	3 May	C	5738	86	R	891	104	1200	0:50
23	ACT-2	3 May	T	892	104	B	1255	86	1200	0:50
24	ACT-2	4 May	R	883	104	H	1231	86	1240	0:40
25	ACT-2	4 May	T	891	104	A	2113	86	1240	0:50
26	ACT-3	4 May	A	2113	86	T	891	104	1640	0:50
27	ACT-3	4 May	C	738	86	S	883	104	1640	0:50
28	ACT-3	5 May	A	113	86	S	892	104	1045	0:45
29	ACT-4	5 May	T	883	104	C	738	86	1045	0:45
30	ACT-4	5 May	R	892	104	A	113	86	1340	0:40
31	ACT-4	5 May	S	883	104	C	738	86	1345	0:45
32	ACT-5	6 May	B	255	86	U	891	104	1000	0:30
33	ACT-1	6 May	D	231	86	T	892	104	0930	0:40
34	ACT-5	6 May	B - D	255-231	86	R - S	891-892	104	1320	0:50
35	ACT-6	7 May	T - S	883-891	104	C - D	738-113	86	1000	0:45

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F-86H versus F-105D/F

TAC Mission FF-857 ACT Evaluation - Summary

<u>Card #</u>	<u>Mission</u>	<u>Date</u>	<u>Attacker</u>	<u>A/C #</u>	<u>Type</u>	<u>Defender</u>	<u>A/C #</u>	<u>Type</u>	<u>T.O. Time</u>	<u>Fly Time</u>
40	ACT-1	26 Apr	G	225	86H	Q	531	105D	1350	0:45
41	ACT-1	26 Apr	E	738	86H	M	530	105D	1350	0:45
42	ACT-1	28 Apr	F	294	86H	N	530	105D	1420	0:50
43	ACT-2	28 Apr	M	531	105D	H	231	86H	1430	0:50
44	ACT-2	29 Apr	O	525	105D	G	225	86H	1420	0:45
45	ACT-2	29 Apr	N	338	105F	H	231	86H	1400	0:40
46	ACT-3	30 Apr	A	113	86H	N	531	105D	0900	0:50
47	ACT-3	30 Apr	E	738	86H	P	525	105D	0900	0:40
48	ACT-4	30 Apr	P	525	105D	H	231	86H	1200	0:50
49	ACT-4	30 Apr	N	531	105D	E	738	86H	1200	0:45
50	ACT-5,6	30 Apr	M	338	105F	A	113	86H	1500	0:50
			L	525	105D	H	231	86H		

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F-86H versus F-4C

## TAC MISSION FF-857 ACT Evaluation - Summary

<u>Card #</u>	<u>Mission</u>	<u>Date</u>	<u>Attacker</u>	<u>A/C #</u>	<u>Type</u>	<u>Defender</u>	<u>A/C #</u>	<u>Type</u>	<u>T.O. Time</u>	<u>Fly Time</u>
1	ACT-1	3 May	A	113	86	V	435	4	0830	0:50
2	ACT-1	3 May	H	231	86	W	512	4	0830	0:45
3	ACT-1	3 May	A	113	86	Z	625	4	1120	0:50
4	ACT-2	3 May	V	435	4	H	231	86	1120	0:50
5	ACT-2	4 May	Y - V	512	4	D	294	86	1200	0:50
6	ACT-2	4 May	W	435	4	B	255	86	1200	0:50
7	ACT-3	4 May	B	255	86	X	625	4	1600	0:50
8	ACT-3	4 May	D	231	86	Y - V	512	4	1600	0:50
9	ACT-3	4 May	B	255	86	W	625	4	1005	0:50
10	ACT-4	5 May	V	435	4	H	231	86	1005	0:50
11	ACT-4	5 May	V	225	4	B	512	86	1305	0:50
12	ACT-4	5 May	W	625	4	D	231	36	1310	0:50
13	ACT-3	6 May	C	238	86	W	512	4	1005	0:50
14	ACT-1	6 May	A	113	86	Z	435	4	1010	0:45
15*	ACT-5	7 May	B - AA	255-231	86	V - X	512-435	4		
16*	ACT-6	7 May	V - X	512-435	4	B - AA	255-231	86	0920	0:50

\* NOTE: #15 and #16 flown on same mission.

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ANNEX B  
TEST DATA CARDS

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**3. I.H. Dutta**

Pool Name	Altitude	Max	Level Max C	A/C
1	1000	1000	1000	1000
2	1000	1000	1000	1000
3	1000	1000	1000	1000
4	1000	1000	1000	1000
5	1000	1000	1000	1000
6	1000	1000	1000	1000
7	1000	1000	1000	1000
8	1000	1000	1000	1000
9	1000	1000	1000	1000
10	1000	1000	1000	1000
11	1000	1000	1000	1000
12	1000	1000	1000	1000
13	1000	1000	1000	1000
14	1000	1000	1000	1000
15	1000	1000	1000	1000
16	1000	1000	1000	1000
17	1000	1000	1000	1000
18	1000	1000	1000	1000
19	1000	1000	1000	1000
20	1000	1000	1000	1000
21	1000	1000	1000	1000
22	1000	1000	1000	1000
23	1000	1000	1000	1000
24	1000	1000	1000	1000
25	1000	1000	1000	1000
26	1000	1000	1000	1000
27	1000	1000	1000	1000
28	1000	1000	1000	1000
29	1000	1000	1000	1000
30	1000	1000	1000	1000
31	1000	1000	1000	1000
32	1000	1000	1000	1000
33	1000	1000	1000	1000
34	1000	1000	1000	1000
35	1000	1000	1000	1000
36	1000	1000	1000	1000
37	1000	1000	1000	1000
38	1000	1000	1000	1000
39	1000	1000	1000	1000
40	1000	1000	1000	1000
41	1000	1000	1000	1000
42	1000	1000	1000	1000
43	1000	1000	1000	1000
44	1000	1000	1000	1000
45	1000	1000	1000	1000
46	1000	1000	1000	1000
47	1000	1000	1000	1000
48	1000	1000	1000	1000
49	1000	1000	1000	1000
50	1000	1000	1000	1000
51	1000	1000	1000	1000
52	1000	1000	1000	1000
53	1000	1000	1000	1000
54	1000	1000	1000	1000
55	1000	1000	1000	1000
56	1000	1000	1000	1000
57	1000	1000	1000	1000
58	1000	1000	1000	1000
59	1000	1000	1000	1000
60	1000	1000	1000	1000
61	1000	1000	1000	1000
62	1000	1000	1000	1000
63	1000	1000	1000	1000
64	1000	1000	1000	1000
65	1000	1000	1000	1000
66	1000	1000	1000	1000
67	1000	1000	1000	1000
68	1000	1000	1000	1000
69	1000	1000	1000	1000
70	1000	1000	1000	1000
71	1000	1000	1000	1000
72	1000	1000	1000	1000
73	1000	1000	1000	1000
74	1000	1000</		

**QUESTION:** Describe key factors for each engagement.

#3 Same as #1 to 3000 ft approx. Then F-4 did un-  
 bracketed roll under and reversed not separated in  
 diving spiral. I could not track due to wing roll at  
 91 - 96.  
 DeWard's Comments: #1 Unloaded a/c + accelerated to  
 92 in lazy climbing turn, then accelerated to 100.  
 Good separation - No Kill.  
 #2 - Slicing roll to right - Roll under to left - 50 ft under to  
 right at 100. Good separation - No Kill.  
 #3 - Made slicing turn to left + unloaded a/c. Vertical  
 roll to left going down, unloaded at 100 roll to right -  
 straight wings level pullout - No kill.  
 (F-4C needs more visual mirrors in back cockpit. Fewer  
 cockpit mirrors need repositioning.)

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TEST DATA 1 - PAC MISSION 857 - ACT 1, 2, 3  
(Fill in blanks; cross out inapplicable entries)

Pilot: \_\_\_\_\_ A/C Type: F4C Date: \_\_\_\_\_ TO Time: \_\_\_\_\_ Fly Time: \_\_\_\_\_  
Attacker: \_\_\_\_\_  
Defender: F4C

Maneuver Log

1. Attacker

Type Attacker: \_\_\_\_\_

Initial Speed/Altitude: \_\_\_\_\_

Terminal (3000') Speed/Altitude: \_\_\_\_\_

High Speed Y0-Y0: \_\_\_\_\_

Roll Off: \_\_\_\_\_

Low Speed Y0-Y0: \_\_\_\_\_

Gun Kill? \_\_\_\_\_

2. Defender (Initial Speed/Altitude): \_\_\_\_\_

Speed: \_\_\_\_\_

Attacker Over Shoot: \_\_\_\_\_

Speed/Altitude: \_\_\_\_\_

Scissors, & Reversals: \_\_\_\_\_

High G Roll Over: \_\_\_\_\_

Recovery Speed/Altitude: \_\_\_\_\_

High G Roll Under: \_\_\_\_\_

Recovery Speed/Altitude: \_\_\_\_\_

Recovery Achieved? \_\_\_\_\_

Gun Kill? \_\_\_\_\_

1.	2.	3.	4.	5.
6/44	6/44	6/44	6/44	
75/40.75	40.75	7/30	7/30	
2m:45	33m:19	45m:19	45m:19	
N00	N0	N0	N0	N0
N0	N0	N0	N0	N0
N0	N0	N0	N0	N0
N0	N0	N0	N0	N0
55/50	85/50	82/50	52/50	
N0	N0	N0	N0	N0
N0	N0	N0	N0	N0
-	-	-	-	-
-	-	-	-	-
N0	N0	N0	N0	N0
-	-	-	-	-
N0	N0	N0	N0	N0
-	-	-	-	-
Yes	Yes	Yes	Yes	Yes
No	No	No	No	No

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2

3. E.M. Time: \_\_\_\_\_ Pool Remains: \_\_\_\_\_ Altitude: \_\_\_\_\_ Mach: \_\_\_\_\_ Level Man G: \_\_\_\_\_ A/C: \_\_\_\_\_

NOTES: Describe key factors for each engagement.

Defender Comments:

#1-When attacker was at 2 miles defender went to 1/4G AB, and accelerated. Achieved Mach 1.0 in 10 sec.

#2- Same except attacker came into 1 mile before was increased air speed.

#3- When attacker was at 1 mile, defender unloaded A/C, then hard turned into attacker and picked up 19, then climbed at .9

#4- Same.

Attacker Comments:

On all attacks as soon as defender started separation maneuver, separation began to increase. In each case attacker didn't maintain a closing advantage when defender started climbing spiral





5  
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TEST DATA - TAC NUMBER 837 - ACT 1.2.3  
(Fill in blanks; cross out inapplicable entries)

3. E.M. DATA

Pool Remains Altitude M Level Max G A/C

Pilot A/C Type A/C # Date TB Time Fly Time  
Attacker F-4C  
Defender F-86H

1. Attacker  
Type Attack  
Initial Speed/Altitude  
Terminal (3200) Speed/Altitude  
High Speed Y-to  
Roll Off  
Low Speed Y-to  
Can Alt?

Engagement #		1.	2.	3.	4.	5.
6/16/41						
83/20						
83/20						
No						
No						
No						
No						
83/20						
Yes						
4.5						
83/20						
Yes						
No						
-						
No						
-						
Pass						
Pass						

NOTES: Describe key factors for each engagement.

#1 - Target started evasive action at 1 mile with loss of visual contact. Rejoin was accomplished with time for one effective pass.  
2000 ft. Cu-Hit Co-aimed (83) 2000 ft by F-4 hard turn forced lateral separation and F-4 disoriented turner with miss passed. Followed by nose low roll, accelerating dive away for successful escape.

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5

7.

**NOTES:** Describe key factors for each engagement.

#1 - Defender entered board descending towards attacker at 2-1/2 mils. Attacker closed by cutting across circle in possible middle - No Gun

4. Kjander based diving turn when attacker

1.550' N. 100° E. 1.550' N. 100° E.

Slacker Creek Park

Initial 30-30° of knee flexion

POSTMAN'S ASSOCIATION

50. RANGE extended to 5000. E decoder failed.

the transitive diving board to climbing rope

Stochastic context-free grammars

Wages: #3 Daily: 40¢ in 1900

11-11-11

1. 1. The first missile was fired at 10:00 AM.

pulling a truck out of it. If debris continues

— ୧୦୮ —

could explain: achieve a mission that a

[illegible]

is fully explained by the delay in delivery

My before achieving 2-3 mile separation.

445 - 12 attacks by ESC Dec 1972 to 82

To these effects

collaborate with the

of the same kind as the one in the first column.

~~Don't attack your position on a gun kill.~~

Wander did not attempt a diving deceleration

no answer for the purpose of low alt. simulation.

11.  $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

THE UNIVERSITY OF CHICAGO

punish a sinner against a ground

background:

2007 MAR 2 - SAC MISSING 037 - ACT 032  
 (Fill in blanks; cross out empty/usable entries)

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Pilot \_\_\_\_\_ A/C Type \_\_\_\_\_ Date \_\_\_\_\_ 30 Time \_\_\_\_\_ Fly Time \_\_\_\_\_  
 Attacker \_\_\_\_\_ F-16H  
 Defender \_\_\_\_\_ F-4C

Engagement 0		1	2	3	4	5
1. Attacker	Type Attack	5/16	6/16	7/16		
	Initial Speed/Altitude	84/10	84/30	86/25		
	Turned on (On/Off)	44°	20°	20°		
	Barrel Roll Attack	Ni	Ni	Ni		
	Missile Kill? Range & Angle Off	Ni	Yes	Yes		
	Turned on: Gun Attack (3000 ft)	--	--	44°		
	High Speed Yo-Yo	No	No	No		
	Roll Off	Ni	No	Ni		
	Low Speed Yo-Yo	Ni	No	Ni		
	Gun Kill?	Ni	No	Ni		
2. Defender	Initial Speed/Altitude	88/15	82/15	88/20		
	Turned on: Gun Attack	Yes	Yes	Yes		
	Missile Attack Deflected	Yes	Yes	Yes		
	Barrel Roll Attack	Ni	Ni	Ni		
	Vertical Rolling Maneuver	Ni	Ni	Ni		
	Attacker Over Shoulder Speed/Altitude	Yes	Yes	Yes		
	Escape Achieved?	Ni	Ni	Ni		
	Gun Kill?	Ni	Ni	Ni		

Notes: Descriptive key factors for each engagement.

Defender's Comments:  
 2-1st attack initiated at 35M, attacker in blind area. Evade  
 maneuver successfully by max gun diving (3 to 6) turn to 132  
 14M, 16-17M moderate but not enough to prevent acceleration.  
 Attacker was observed 25 to 30° - 055 min range 4500 ft. in  
 first third of maneuver. 1st attack in blind, 60° locked area  
 at 20M-max gun locked turn (3-6) for about 120° at 94 then  
 maneuver (25-6) acceleration to 13M, 14M in saturation turn-  
 turn was started 7-8M ft, range attacker was not observed at all.  
 Attacker's Comments:  
 2-1st attack started at 40M with defender at 35M - not able to  
 reach high enough max to close properly and ended in a tail  
 chase. 1st turn 100° to lock defender turn and would not permit  
 a shot in the 20° cone with less than 400 ft. Defender called  
 enemy prior to close to gun range.  
 2-2nd attack started at 38M with defender at 35M. When at  
 100° 1st turn 100° placed a missile shot with less than 200 ft.  
 2nd turn 100° shot at max gun range.  
 3-3rd attack started at 25M with defender at 20M.  
 Defender never saw me when I was in missile  
 range or gun range.

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10. CONFIDENTIAL

TEST DATA 2 - SAC MESSAGE 837 - ACT 2-62  
(Fill in blanks; cross out inapplicable entries)

Attacker \_\_\_\_\_ A/C Type F-4C Date \_\_\_\_\_ Altitude \_\_\_\_\_ Mach \_\_\_\_\_ Level/Type G \_\_\_\_\_ A/C \_\_\_\_\_  
Defender \_\_\_\_\_  
Remarks F-4C

1. Attacker  
Type Attack \_\_\_\_\_  
Initial Speed/Altitude \_\_\_\_\_  
Turned: (On/Off) Speed/Angle Off \_\_\_\_\_  
Barrel Roll Attack \_\_\_\_\_  
Missile Kill? Range & Angle Off \_\_\_\_\_  
Turned: On Attack (200°) \_\_\_\_\_  
High Speed Yo-Yo \_\_\_\_\_  
Roll Off \_\_\_\_\_  
Low Speed Yo-Yo \_\_\_\_\_  
Gun Kill? \_\_\_\_\_  
2. Defender - Initial Speed/Altitude \_\_\_\_\_  
Hard Turn/Break \_\_\_\_\_  
Missile Attack Deflected GWR \_\_\_\_\_  
Evading Spiral \_\_\_\_\_  
Vertical Rolling Scissors \_\_\_\_\_  
Attacker Over Shoot Speed/Altitude \_\_\_\_\_  
Escape Achieved? \_\_\_\_\_  
Gun Kill? \_\_\_\_\_

NOTES: Describe key factors for each engagement.  
Defender's Comments:  
#1 - After break and observing overshoot did not have any opportunity to get into gun or missile position.  
#2 - Same as #1, however as attacker came out of yo-yo was able to reverse and fall into six o'clock about 3000-4000 feet at about 20-30 degree off, 20's.  
#3 - Never did have attacker in sight until he called soon set and tracking. This was after defeating initial missile.  
#4 - Same as #1.  
#5 - Attacker tried to turn (after initial overshoot) with me. Had trouble with tracking, however could not climb or even maintain altitude while attempting to gain advantage. ATTACKER'S COMMENTS:  
CARB attack was detected and passed recognition and position. Successful attacks were excellent for sparrows kill. Shoulder harness being frequently caused loss of visual sighting. Testament of hands should be removed for better rear vision. Emphasis was placed on evading missile, envelope vision best during trail G. On third attack the gun's roll off allowed 30° deflection shot tracking more than 2000 ft. to 1000 ft. with little closure. If speed on attacker's apparent launch on target. Steep diving setbacks at high Mach were completely unsuccessful due to difficulty in dive recovery. Would be extremely useful as an escape maneuver.

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REF ID: A7 - SAC MISSION 437 - ACT 2.1.1  
(Fill in blanks; cross out inapplicable entries)

Pilot	A/C Type	A/C #	Date	TO Time	Fly Time
Attacker	3-40				
Defender	2-40				
1. AIRCRAFT					
Type Attack					
Initial Speed/Altitude					
Terminal: (Missile) Speed/Angle Off					
Barrel Roll Attack					
Missile Kill? Range & Angle Off					
Terminal: Gun Attack (3000'?)					
High Speed Yo-Yo					
Roll Off					
Low Speed Yo-Yo					
Gun Kill?					
2. Defending - Initial Speed/Altitude					
Head Turn/Break					
Missile Attack Deflected					
Evading Spiral					
Vertical Rolling Defense					
Attacker Gun Shoot: Speed/Altitude					
Escape Achieved?					
Gun Kill?					

1. 6	7	3	4	5
STEEN	STEEN			
2301	2301			
91M	91M			
95M10	1.1M10			
No	No			
No	No			
No	400' 55M			
No	No			
No	Yes			
No	No			
No	Yes			
8/20	8/20			
Yes	Yes			
Yes	Yes			
Snar S	Snar S			
No	No			
No	No			
Yes	No			
No	No			

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NOTE: Describe key factors for each engagement.

Attacker Comments: #1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100.

11a.

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TEST DATA 2 - THE MISSION 107 - ACT 2, 02  
(Fill in blank/ cross out (applicable) entries)

File: A/C Type A/C # Date TO Time Fly Time

Attacker: 24C  
Defender: 36H

Remarks:

1.	2.	3.	4.	5.
1. Attacker	H.S.L.	H.S.L.	Stem	H.S.L. Stem
Type Attack	91/32M	91/32M	22/23M	27/24M
Initial Speed/Altitude	1000	1000	2000	1000
Terminal: (Missile) Speed/Angle Off	1.101	1.201	1.101	1.1
Barrel Ball Attack	No	No	Yes	No
Missile Kill? Range & Angle Off	Yes	No	No	No
Terminal: Gun Attack (3000'?)	1.101	1.101	No	No
High Speed Yo-To	Yes	No	Yes	No
Roll Off	No	Yes	No	Yes
Low Speed Yo-To	Yes	No	No	No
Gun Kill?	Yes	Yes	Yes	Yes
2. Defender - Initial Speed/Altitude	85/35	8/35	25/22	25/20
Yard Turn/Head	Yes	Yes	Yes	Yes
Missile Attack Defeated	No	Yes	Yes	Yes
Clwing Spiral	No	No	No	Yes
Vertical: Rolling Sensors	No	No	No	No
Attacker Over Shoot Speed/Altitude	No	Yes	Yes	Yes
Escape Achieved?	No	No	Yes	Yes
Gun Kill?	No	No	No	No

Notes: Describe key factors for each engagement.

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13 CONFIDENTIAL

REF ID: A67 - THE REVISION 617 - 422 2 3 4 5  
(Fill in blanks; cross out inapplicable entries)

Plat: A/C Type: F-4C Date: 20 Jan 68 Fly Time: 1:10  
Attacker: F-4C Defender: F-4C

1.	2.	3.	4.	5.
6/11: 6/11: 6/11: 6/11: 6/11:				
8/25: 8/25: 8/25: 8/25: 8/25:				
9/10: 9/10: 9/10: 9/10: 9/10:				
10/10: 10/10: 10/10: 10/10: 10/10:				
11/10: 11/10: 11/10: 11/10: 11/10:				
12/10: 12/10: 12/10: 12/10: 12/10:				
13/10: 13/10: 13/10: 13/10: 13/10:				
14/10: 14/10: 14/10: 14/10: 14/10:				
15/10: 15/10: 15/10: 15/10: 15/10:				
16/10: 16/10: 16/10: 16/10: 16/10:				
17/10: 17/10: 17/10: 17/10: 17/10:				
18/10: 18/10: 18/10: 18/10: 18/10:				
19/10: 19/10: 19/10: 19/10: 19/10:				
20/10: 20/10: 20/10: 20/10: 20/10:				
21/10: 21/10: 21/10: 21/10: 21/10:				
22/10: 22/10: 22/10: 22/10: 22/10:				
23/10: 23/10: 23/10: 23/10: 23/10:				
24/10: 24/10: 24/10: 24/10: 24/10:				
25/10: 25/10: 25/10: 25/10: 25/10:				
26/10: 26/10: 26/10: 26/10: 26/10:				
27/10: 27/10: 27/10: 27/10: 27/10:				
28/10: 28/10: 28/10: 28/10: 28/10:				
29/10: 29/10: 29/10: 29/10: 29/10:				
30/10: 30/10: 30/10: 30/10: 30/10:				

NOTES: Describe key factors for each engagement.

Defender's Comments:

#1-Defender initiated 20°-30° climb descending turn when attacker at 1000'. Built up to 5000' at 11:00. Attacker closed to 5000' and was rolling 30°-40° (30° off), then came around rapidly.  
#2-Defender initiated 20°-30° climb descending turn when attacker at 5000'. C: 11:00 built to 4:12. Attacker closed to 4000'. 30°-40° then defender keeping C: 11:00 rapidly separated. Terminal altitude 11:00.  
#3-Defender initiated 20°-30° climb descending turn accelerated to 125 MW 4:12. When attacker was approaching attacker closed to 5000'. 20°-30° off approx. 3:00. Terminated as defender started rapid separation.  
#4-Attacker was inside 3000' when defender was maneuvering. Attacker could have made a kill.  
Attacker's Comments:  
#1-Attacker called 20°-30° climb initiated 3000' during turn. Attacker closed to 5000'. 30°-40° off approx. 3:00. off separation was accomplished.  
#2-Defender delayed maneuvered to approx 5000' closing to 3000'. Attacker closed to 4000' still 30°-40° off.  
#3-Summary to #1-defenders shallow diving turn to accelerate. Separation completed during below 5000' with 30°-40° minimum at min. range of 5000'.

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INVEST DATA 2 - THE MINIMUM 827 - 46-275-1  
(FILL IN BLANKS; SEE SOME INSTRUCTIONS)

## **2. 数据源**

Pool Name	Altitude	Month	Level/Max	Δ/c
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
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92				
93				
94				
95				
96				
97				
98				
99				
100				

Slit	Ac Type	A/C #	Date	20 Time	Fly Time
October 1.					
2.					
October 1.					
2.					

**NOTES:** Describe key factors for each engagement.

Attackers Comments - #1 - Attackers on D-2 - D-2 made Pt. turn. A-1 + 2 stayed on D-2 until D-1 started attack on A1 + 2. Team A1 + 2 turned into D-1 making D-1 escape. Gun. No gun kills for either side. Attackers caused a Def. split however, Def. made successful escapes with AB counter attack (Speed). #2. A-1 + 2 made oval and vertical pass picking out D-2 - D-2 made a left turn with A-1 + 2 passing in for a Prob. Gun kill. D-1 made attack on A1 + 2 causing A1 + 2 to break off D-2 but not before A1 was shot down by D-1. A-2 did not judge D-1 range quick enough to call break. Defenders Comments: #1 - A1 on D-2 (on pt. side) D-1 + 2 accelerated to kill closure rate at 4200' range. Pt. turn by D-1 + 2 with D-1 on outside called hi and in on A1 forcing A1 to break off D-2 and break into D-1 with no offensive positioning avail. D-1 + 2 effectively broke off engagement and away. #2 - A-1 + A-2, hi rate of closure on D-2 off pt. side at 4500-5000. D-1 + 2 asked to kill closure rate and D-2 made left turn to decim off A1 + 2 + offer defensive split. D-1 when ahead A1 + 2 - hand kill upon overtake behind D-2 with 1.05 mil. Closing 3-5 sec. tracking shot to 2000' Good snap shot plan view. 500' with slow cross over - Escape successful for D-1 + 2 as a unit.

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TEST DATA 2 - TAC MISSION 157 - ACT 2.0  
(Fill in blanks; cross out inapplicable entries)

Pilot: A/C Type: A/C # Data TO Time Fly Time

Attacker 1. F-4C

2. F-4C

Defender 1. F-4C

2. F-4C

Maneuver Log

1. Attacker

Type Attack

Tactical (Missile) Speed/Angle Off

Missile Kill? #, Range, C, Angle Off

Tactical: Gun Attack (3000')

High Man/Field Separation

High Speed/Low Speed Ye-No

Gun Kill? #

2. Defender

Initial Speed/Altitude

Hard Turn/Track

Missile Attack Deflected?

Defensive Split

Reversal (Under/Over)

Swivel/Zooms Achieved

Gun Kill? #

NOTES: Describe key factors for each engagement.

Defender's Comments:

#1-Defender #102 made hard left turn at about 7000'. Attacker #102 could not track as yet into position. Attacker #102 pulled off high. Defender #102 achieved escape. Attacker could not take on head-on attack. #2- Slight break pass on defender #1 then switched to defender #2. Defender #2 made a break to late causing a gun kill on him by attacker #1. Attacker #1 turned into attacker #102 head on pass but was unable to reverse with enough time to do any good.

Attacker's Comments:

#1- Attacker #102 submarine attempted pass on Defender #2 (right side). Defender #102 left break at 3500, 7000 ft (phs) range. Break off #2- Attacker #102 from his quartering stern dropped down - closing in at 1000 - in the same C2 position. He was at 1500 ft. Break to right was initiated - gun kill.

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7

## 2. Math

Peak Name	Altitude	Mass	Wt.
1	10,000	100	100
2	10,000	100	100
3	10,000	100	100
4	10,000	100	100
5	10,000	100	100
6	10,000	100	100
7	10,000	100	100
8	10,000	100	100
9	10,000	100	100
10	10,000	100	100
11	10,000	100	100
12	10,000	100	100
13	10,000	100	100
14	10,000	100	100
15	10,000	100	100
16	10,000	100	100
17	10,000	100	100
18	10,000	100	100
19	10,000	100	100
20	10,000	100	100
21	10,000	100	100
22	10,000	100	100
23	10,000	100	100
24	10,000	100	100
25	10,000	100	100
26	10,000	100	100
27	10,000	100	100
28	10,000	100	100
29	10,000	100	100
30	10,000	100	100
31	10,000	100	100
32	10,000	100	100
33	10,000	100	100
34	10,000	100	100
35	10,000	100	100
36	10,000	100	100
37	10,000	100	100
38	10,000	100	100
39	10,000	100	100
40	10,000	100	100
41	10,000	100	100
42	10,000	100	100
43	10,000	100	100
44	10,000	100	100
45	10,000	100	100
46	10,000	100	100
47	10,000	100	100
48	10,000	100	100
49	10,000	100	100
50	10,000	100	100
51	10,000	100	100
52	10,000	100	100
53	10,000	100	100
54	10,000	100	100
55	10,000	100	100
56	10,000	100	100
57	10,000	100	100
58	10,000	100	100
59	10,000	100	100
60	10,000	100	100
61	10,000	100	100
62	10,000	100	100
63	10,000	100	100
64	10,000	100	100
65	10,000	100	100
66	10,000	100	100
67	10,000	100	100
68	10,000	100	100
69	10,000	100	100
70	10,000	100	100
71	10,000	100	100
72	10,000	100	100
73	10,000	100	100
74	10,000	100	100
75	10,000	100	100
76	10,000	100	100
77	10,000	100	100
78	10,000	100	100
79	10,000	100	100
80	10,000	100	100
81	10,000	100	100
82	10,000	100	100
83	10,000	100	100
84	10,000	100	100
85	10,000	100	100
86	10,000	100	100
87	10,000	100	100
88	10,000	100	100
89	10,000	100	100
90	10,000	100	100

Call	A/C #	A/C Type	Date	TO Time	VLY Time
1011	1011	1011	1011	1011	1011

[illegible][illegible]

**1991 January**

**2. Answer**

2007-07-26

Initial Speed/Altitude

Operator/Prods (N, D, X): 000000

01-01 9000 4712

319 1168

2005 4571

11-13 cm

23702

2025 2024 2023 2022 2021

100

# Section 4 - Personal

2025-03-27

1-800-875-5273

**SECRET**

Internet Search - 1914-1918

Doc. 1047-19

Page 11 of 11

**NOTES:** Describe key factors for each engagement.

Attacker's Comments: #1 Attacker started down from 40M and had no trouble staying inside turn at all times ranging down to give nice position. #2 Started from 37N and B deleted, dropped down and low to pick up speed and then stayed with him throughout downwind turn. #3 - Started at 35M and #87. Overshot and high to bid on outside. Defender turned toward me & climbed in AB then rolled over to the right, my turn to follow him down. Presented no problems.

Debroderes Comments:

#1 Level break 500' land faps. Unable to get F-86 to overshoot.

#20 Break 5000' High G diving - No  
acceleration. Unable to get acceleration.  
See page 10 and sheet.

#3 Breast 4000' Climbing high 57. No  
breastshoot - them called only 15

for escape maneuver but was too late to be effective.

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24.

24.

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107-9671 - DC MEXICO 837 - 457 ©

	Folio	A/C No.	Date	TD Time	Ply Time
Transfer		8807-6			
Transfer		HOB-3			

**151-100000**

**1. Answer**

**TYPE AREA**

**1913-14: 101376**

Ref: (S) Speed/Volvo

01-02 90065 691X

**3:9 1164**

67-84 2025 447

**10-75 600**

REPORT OF THE COMMISSIONER OF THE GENERAL LAND OFFICE

2001 Hard Turns

2009 JAN 20 2011

07-11274, 20045

SECRET

44,400 lbs.

**positive, party loyalty**

Page 10 of 10

## Recovery Speed, Amplitude

**Exposure Assessment:**

600 211

**NOTES:** Describe key factors for each engagement.

Reverend's Comments:

#1 Attacker appeared to be tracking with defender in back turn. Difficult to judge distance because of size of pit. Thought attacker was out of range when actually he was 200-300 yds. Could not shoot still seeing back turn but was unable to close to less than 400 yds.

#2 Could not see attacker. Attacker called back, covered own shot but could not give advantage.

#3 Will hold firm. I never overheat. Will continue to grow adverse.  
 Page 434. Trying to better high speed engine.  
 #4 Will hold firm. Will still continue to grow. I believe that  
 by using truck I will have several almost all best.  
 I expect to judge and judge.  
 My above. You must try.

#1 J. Stewart hard turned at 500 ft range, 1st attack speed 1.2 at 300 ft able to track for 3 seconds then crashed. Broken down into diving second and missed.

#2 - Check at which called dependent by 1st of month. All to track & receive.

Wed. 30th performed last turn at 4000' usually to track while in gear  
range. We were surprised on.

**WILKINSON**



REF ID: A622 - THE MISTON 227 - 12/2/22

2. I.M. Tera

Altitude	Mach	Level/Max G	A/E
Fuel Remains			

**NOTES:** Describe key factors for each engagement.

Deborah C. Green

#1 - Increased # of orders to special missile steadily increasing from 2000 to 2005.

2-Hauslebauch 22 mg + Reticular cell-steroid down 25%  
essen.

# 3 - Last right of Shaker at 10:10 AM before execution  
by hanging by the neck from gallows.  
The time of day

25th Made a belch climb for an after at 11:30. The  
aspens - birds and others of birds was able to get the birds as usual.  
Came back was effective position on the back of the mountain.  
The second day 2 birds were seen on the mountain.

Attorney General

\* I will turn in my first effort. I decided not to use during the first 2 weeks. Sun. Will write again at 11:00 AM. next 4th. C's.

# 4- Will separate each individual part of book by subjecting them to  
Covers and title & chapter

#3 104-Dad saw me at 6 o'clock started back turned 180° & closed & tracked thru reversed and drove with rolls & bumps in reverse all the time.

#4. 104 started climbing for a when I was at 5016 ft. I climbed  
the west side of the mountain, with no call sign, and his back at  
100-300 ft. range.

#5-104 did hard climbing turn. I stayed within 300 ft. of tracking all the way.

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27.

TEST DATA 2 - SAC MESSIAH 017 - ACFT 2  
CRUISE in climbing cruise (no applicable entries)

Altitude \_\_\_\_\_ A/C Type \_\_\_\_\_ Date \_\_\_\_\_ TO Time \_\_\_\_\_ Fly Time \_\_\_\_\_  
Altitude \_\_\_\_\_ E-8H  
Defender \_\_\_\_\_ E-105C

1. ATTACKER

2. DEFENDER

3. RESULTS

4. COMMENTS

5. SUMMARY

6. CONCLUSIONS

7. RECOMMENDATIONS

8. REFERENCES

9. APPENDICES

10. INDEX

11. GLOSSARY

12. ABBREVIATIONS

13. SYMBOLS

14. REFERENCES

15. APPENDICES

16. INDEX

17. GLOSSARY

18. ABBREVIATIONS

19. SYMBOLS

20. REFERENCES

21. APPENDICES

22. INDEX

23. GLOSSARY

24. ABBREVIATIONS

25. SYMBOLS

26. REFERENCES

27. APPENDICES

28. INDEX

29. GLOSSARY

30. ABBREVIATIONS

31. SYMBOLS

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100-100000 - 100000 - 100000

## 2. 2.1.7.2.2

Pool Name	Alcivide	Mesh	Low1/Max 6	$\Delta/\epsilon$
-----------	----------	------	------------	-------------------

Files	A/C Type	A/C @	Date	20 Time	7:7 Time
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100					

Attorney	<u>F-86</u>
Defender	<u>F-104</u>

**Warrant for**

## 2. Discussion

**450737 243**

**2012-11-20 09:04/AL02 05-40**

**Fax: 513 (618) 366/4616**

**Envel 101 Attach**

**The 17th & 18th**

(U.S.G.) 70000 and 190000.

## High Speed Test

2011 068

**EX-01 page no.1**

6-11151-439

## 2. Prüfung - Latent Speed/Velocity

Hard Data/Results

## Wallo Attack Defeated

**Water Control**

**Section 101 of 1972**

**ATTENTION: THIS BOOK! IS NOT A REFERENCE**

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**SECRET**

**NOTES:** Describe key factors for each engagement.

Doctors Comments:

When attacked was within 1000 ft started back town with  
himself (as the gun malfunctioned) was unable to  
get over the 600 ft. Gun will was subjected when  
within 100 ft. Unloaded and attempted to  
shoot at the side of the road as he was running  
towards the cigarette

[illegible][illegible][illegible][illegible]

1905

74 one road at 11.11.11

224 Hillside, 125 10th 240 Kts.

1. The first part of the document is a list of names and their corresponding addresses. The names are: John Doe, Jane Smith, and Bob Johnson. The addresses are: 123 Main St, 456 Elm St, and 789 Oak St.

[illegible]

11-11-11

1-12-64 started with Tollen's test for aldehydes. Wrote  
improvement to the test for aldehydes.

limited to 1000 lbs. weight and closed to 2400.

But got gun kill with 56 in F-86.

unobtainable

3-104 218 2nd & 1st turn again limited by Kicker. I

decreasing with

from 96 to 265 kts.

mil-F104 unloaded in diving right tread with 425 lbs  
to avoid excessive tank. T allowed to 9200 ft. but

78 2020: 8 21:55:10 01/04/2020: 10 1 2020: 37:20:01

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TEST DATA 2 - TAC MISSION 037 - ACT 26.1  
(Fill in blanks; cross out inapplicable entries)

File #	A/C Type	A/C #	Date	TD Time	Fly Time
Acrocher	710AC				
Boomer	7186				

Statement	Segment #			
	1	2	3	4
1. <u>ATTACK</u>				
Type Attack	THH	5/10	5/10	8/11
Initial Speed/Altitude	240	10/20	10/20	9/15
Terminal: (Missile) Speed/Angle Off	Examining Ground Speed only			
Barral Roll Attack	No	No	Yes	No
Missile Kill? Range & Angle Off	—	—	—	—
Terminal: Gun Attack (3000'2)	No	No	No	No
High Speed Yo-Yo	No	No	Yes	No
Roll Off	No	No	No	No
Low Speed Yo-Yo	No	Yes	No	Yes
Gun Kill?	No	No	No	No
2. <u>DEFENSE</u> - Initial Speed/Altitude	83/35	83/35	75/15	75/20
Varp Turn/Speed	Yes	Yes	Yes	Yes
Missile Attack Defensed	Yes	Yes	Yes	Yes
Evading Spiral	No	No	Yes	Yes
Vertical Rolling Scissors	No	No	Yes	Yes
Attacker Over Shoot: Speed/Altitude	Yes	No	Yes	Yes
Escape Achieved?	Yes	Yes	Yes	Yes
Gun Kill?	No	No	No	Yes

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[illegible]

30. CONFIDENTIAL

REF: B-2 - 2nd Mission 037 - ACZ 3-0-2  
(Fill in blank areas not applicable entries)

2. E-104

Pool Name: Altitude: Mach: Level/Name: A/C

Pilot: A/C Type: Date: TO Time: Fly Time:

Attacker: E-104  
Defender: E-104

Remarks:

1. Description:

Type Attack:

Initial Speed/Altitude:

Terminal (Mach) Speed/Altitude:

Barrel Roll Attack:

Missile Kill: Range 6 Miles Off:

Terminal: Gun Attack (.300")

High Speed Yo-Yo:

Roll off:

Low Speed Yo-Yo:

Gun Kill:

2. Defenses - Initial Speed/Altitude:

Head Turn/Track:

Vertical Acceleration Defused:

Rolling Spiral:

Vertical Rolling Scissors:

Attacker Over Enemy Speed/Altitude:

Escape Attempt:

Gun Kill:

Notes: Describe key factors for each engagement.

#1. F-16 at 33000 ft. 15 Mach. F-16 attacked at 33000 ft. achieved 1/2 dead astern of defender start hard turn at 33000 ft. 15 Mach. 4 ft. while in gun range. Attacker achieved escape without gun or missile kill.

#2. F-16 at 35000 ft. 15 Mach. 10 ft. quarter stern of defender. 5000 ft. 90. Attacker started distance turn at 45000 ft. Unable to track white on gun range. Attacker reduced power and speed. braked. Overload and defender reversed - set in series of reversals. F-16 on horizon. Escaped down and away. F-16 could have obtained favorable gun position if F-16 had continued with reversal & reversals.

#3. Started break at 5000 ft. F-16. Unable to track white in gun range. - we shot and engaged with diving spiral.

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32.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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**NOTES: Describe key factors for each engagement.**

### Selected Imports:

#1-L-8 called 5:00 p.m. I back left and burn hole inside, candidate 360-

Initial cost very rapid. Good all but should not base attitude on assumed

12 paths in 80 mill sec. made 2-86 track, average pull out. Nov 6-55 H

6. I Met. first and had but did not get once down - did not we spend nothing.

probably day place to a narrow 2'6" sack with under, between. Max 65.  
18: 40

of Jordan to #2 - Plot did not use as much enthusiasm as needed - Aft too much

greater capability. This experiment could be compared to a pilot who might be

placed into contact with mucosa in a perfused

the 1st natural - called definite - 2 mi. - 2% made hard 7-10%

Postscriptally and fully - turn content - content lost in context.  
Oct. 1910

Quilley's Company.

No.	Loc.	Occurrence	Notes	Remarks
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9
10	10	10	10	10
11	11	11	11	11
12	12	12	12	12
13	13	13	13	13
14	14	14	14	14
15	15	15	15	15
16	16	16	16	16
17	17	17	17	17
18	18	18	18	18
19	19	19	19	19
20	20	20	20	20
21	21	21	21	21
22	22	22	22	22
23	23	23	23	23
24	24	24	24	24
25	25	25	25	25
26	26	26	26	26
27	27	27	27	27
28	28	28	28	28
29	29	29	29	29
30	30	30	30	30
31	31	31	31	31
32	32	32	32	32
33	33	33	33	33
34	34	34	34	34
35	35	35	35	35
36	36	36	36	36
37	37	37	37	37
38	38	38	38	38
39	39	39	39	39
40	40	40	40	40
41	41	41	41	41
42	42	42	42	42
43	43	43	43	43
44	44	44	44	44
45	45	45	45	45
46	46	46	46	46
47	47	47	47	47
48	48	48	48	48
49	49	49	49	49
50	50	50	50	50
51	51	51	51	51
52	52	52	52	52
53	53	53	53	53
54	54	54	54	54
55	55	55	55	55
56	56	56	56	56
57	57	57	57	57
58	58	58	58	58
59	59	59	59	59
60	60	60	60	60
61	61	61	61	61
62	62	62	62	62
63	63	63	63	63
64	64	64	64	64
65	65	65	65	65
66	66	66	66	66
67	67	67	67	67
68	68	68	68	68
69	69	69	69	69
70	70	70	70	70
71	71	71	71	71
72	72	72	72	72
73	73	73	73	73
74	74	74	74	74
75	75	75	75	75
76	76	76	76	76
77	77	77	77	77
78	78	78	78	78
79	79	79	79	79
80	80	80	80	80
81	81	81	81	81
82	82	82	82	82
83	83	83	83	83
84	84	84	84	84
85	85	85	85	85
86	86	86	86	86
87	87	87	87	87

Just what we need. Can't wait for it - but it is so good to have something to eat and

How far in advance will I be able to place my order for quantities of 100 or more? Will you

2305 1.0 / 0.5, 1.20, 1.15, 1.15, 1.15

And yet, I have been told that I am a good person.

2. 1944 - 1946 was a back at work.

43 Loran #3 - 4 + 9 ms 0 1 1 1 +

5

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REF ID: A1 - 26 MARCH 197 - 450 2. 3  
(Fill in blanks; cross out inapplicable entries)

File #            A/C Type            Date            TO Time            Fly Time           

Attacker                                 

Defender                                 

Remarks                                 

1. Attacker	Engagement #			
	1.	2.	3.	4.
Type Attack	7/11	4/11	5/11	7/11
Initial Speed/Altitude	16/125	86/125	86/125	86/125
Formation: (3X0's) Speed/Altitude	94/120	94/120	96/120	96/120
High Speed Y0-Y0	No	No	Yes	No
Roll Off	No	No	Yes	No
Low Speed Y0-Y0	No	No	No	No
Can Kill?	Not	No	Yes	No
2. Defender (Initial: Speed/Altitude)				
Speed	350/160	350/160	325/122	350/121
Attacker Over Board	No	No	Yes	No
Speed/Altitude	No	No	No	No
Schedule, & Reversals	-	-	-	-
High G Roll Over	-	-	Yes	-
Recovery Speed/Altitude	No	No	No	No
High G Roll Over	No	Yes	No	Yes
Recovery Speed/Altitude	13/154	12/104	25/11	20/11
Escape Achieved?	Yes	Yes	No	Yes
Can Kill?	No	No	No	No

3. 2. M. TUBEL

Foot Length            Altitude            Mach            Level New 6            A/C           

NOTES: Describe key factors for each engagement.

Attacker's Comments:

#1: Attacker came in about 20' off the tail. At 3000' range I tried to reg. G. quarter roll straight away escape. Attacker tracked in to 2200' prior to my separation.

#2: Same as #1. At 3000' range dropped flaps, rolled back 10° and spiralled away. Lost the attacker immediately.

#3: At about 3000' range I broke up and into the attack. Attacker tracked from feet decelerate then overtook and yo-yoed high for re-attack. No contact.

#4: Same as 3. Only I spiralled down and away and had no problem with this escape.

Attacker's Comments:

#1: Was able to track and get to within 2200' gun range before separation. G's proved difficult to keep tracking.

#2: Lost 1. At 3000' range and target started right turn and spiral down. My action prevented any track on shot at any time.

#3: Called at 3000' and target tried to pull up and into attacker and reverse - this maneuver prevented me with a 1600' range and good target tracking.

#4: Called at 3000' range and target broke down and away. I was unable to track or close.

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**34 CONFIDENTIAL**

(Call in blanks; comes out inapplicable entries)

X-9-67 - 678 NUMBER ONE - TOWN LINE

### **3. E.L. Davis**

Pool Name	Altitude	Week	Level/Max	$\Delta/\%$
1	1000	1	1000/1000	0/0
2	1000	2	1000/1000	0/0
3	1000	3	1000/1000	0/0
4	1000	4	1000/1000	0/0
5	1000	5	1000/1000	0/0
6	1000	6	1000/1000	0/0
7	1000	7	1000/1000	0/0
8	1000	8	1000/1000	0/0
9	1000	9	1000/1000	0/0
10	1000	10	1000/1000	0/0
11	1000	11	1000/1000	0/0
12	1000	12	1000/1000	0/0
13	1000	13	1000/1000	0/0
14	1000	14	1000/1000	0/0
15	1000	15	1000/1000	0/0
16	1000	16	1000/1000	0/0
17	1000	17	1000/1000	0/0
18	1000	18	1000/1000	0/0
19	1000	19	1000/1000	0/0
20	1000	20	1000/1000	0/0
21	1000	21	1000/1000	0/0
22	1000	22	1000/1000	0/0
23	1000	23	1000/1000	0/0
24	1000	24	1000/1000	0/0
25	1000	25	1000/1000	0/0
26	1000	26	1000/1000	0/0
27	1000	27	1000/1000	0/0
28	1000	28	1000/1000	0/0
29	1000	29	1000/1000	0/0
30	1000	30	1000/1000	0/0
31	1000	31	1000/1000	0/0
32	1000	32	1000/1000	0/0
33	1000	33	1000/1000	0/0
34	1000	34	1000/1000	0/0
35	1000	35	1000/1000	0/0
36	1000	36	1000/1000	0/0
37	1000	37	1000/1000	0/0
38	1000	38	1000/1000	0/0
39	1000	39	1000/1000	0/0
40	1000	40	1000/1000	0/0
41	1000	41	1000/1000	0/0
42	1000	42	1000/1000	0/0
43	1000	43	1000/1000	0/0
44	1000	44	1000/1000	0/0
45	1000	45	1000/1000	0/0
46	1000	46	1000/1000	0/0
47	1000	47	1000/1000	0/0
48	1000	48	1000/1000	0/0
49	1000	49	1000/1000	0/0
50	1000	50	1000/1000	0/0
51	1000	51	1000/1000	0/0
52	1000	52	1000/1000	0/0
53	1000	53	1000/1000	0/0
54	1000	54	1000/1000	0/0
55	1000	55	1000/1000	0/0
56	1000	56	1000/1000	0/0
57	1000	57	1000/1000	0/0
58	1000	58	1000/1000	0/0
59	1000	59	1000/1000	0/0
60	1000	60	1000/1000	0/0
61	1000	61	1000/1000	0/0
62	1000	62	1000/1000	0/0
63	1000	63	1000/1000	0/0
64	1000	64	1000/1000	0/0
65	1000	65	1000/1000	0/0
66	1000	66	1000/1000	0/0
67	1000	67	1000/1000	0/0
68	1000	68	1000/1000	0/0
69	1000	69	1000/1000	0/0
70	1000	70	1000/1000	0/0
71	1000	71	1000/1000	0/0

[illegible]

## Abstracts



## Appendix 1.



**NOT RECORDED**

## 2. Aspekter

**TYPE A**

**Terminal Cell**

### Discussion

Wesleyville, N.Y., June 5, 1964

**Terminal: Gun Attack (2000)**

**High Mass/High Separation**

02-01 10066 007/10066 4372

\_\_\_\_\_

6-2117-9

\_\_\_\_\_

spas pty/poeds 1011 yz :t:zjzjzjz

**WORLD, WISDOM, POWER**

ALL INFORMATION CONTAINED  
HEREIN IS UNCLASSIFIED

**Defendant's Exhibit**

**Exhibit 1 (Undercover)**

**Submitted on/through:**

0 177 000

**NOTES: Describe key factors for each engagement.**

#1 - Attacker at 5000 mags. F-16's must enter diving spiral escape to preclude a kill. Defensive split allows attackers time to maneuver to offset a kill. F-16 inherited a kill.

#243 - Where simlag was at more lateral separation effective for passive split was not achieved, unable to offer support. If F164 does not immediately depart the scene F-16 can achieve kill.

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3-7 CONFIDENTIAL

REF ID: A67 - THE RECORDS OF - ACT 2 (3) 2  
(Fill in blanks; use one line for each answer)

NAME: A/C Type: A/C # Date: 30 May 1966 Fly Time: \_\_\_\_\_

Attacker 1. F-104

Defender 1. F-16

Attacker 2. \_\_\_\_\_

Defender 2. \_\_\_\_\_

Maneuver Log

1. Altitude

Type Attack

Terminal (Altitude) Speed/Angle Off

Missile Kill? 9, Range, G, Angle Off

Terminal: Gun Attack (3000')

High Man/Flame/Explosion

High Speed/Low Speed No-10

Gun Kill? 9

2. Defenders: Initial Speed/Altitude

Head Turn/Attack

Maneuver Attack Defected?

Defensive Split

Reverral (Under/Over)

End-of-Run/Range Added

Gun Kill? 9

2. E.M. Data

Pool Results

Altitude

Each

Level/Run 6

A/C

Notes: Describe key factors for each engagement.

Attacker initiated the attack from 4000 ft level 5 miles. The defender could not keep both attackers in sight - #1 called off range and angle. Defenders made a defensive split - at about 2 miles.

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TEST DATA - SAC WASHINGTON 837 - 261121  
(fill in blanks; cross out inapplicable entries)

2. 11.25.2011

Pool Name	Altitude	Mach	Level Max G	A/C
1	10,000	0.8	1.5	1
2	10,000	0.8	1.5	1
3	10,000	0.8	1.5	1
4	10,000	0.8	1.5	1
5	10,000	0.8	1.5	1
6	10,000	0.8	1.5	1
7	10,000	0.8	1.5	1
8	10,000	0.8	1.5	1
9	10,000	0.8	1.5	1
10	10,000	0.8	1.5	1
11	10,000	0.8	1.5	1
12	10,000	0.8	1.5	1
13	10,000	0.8	1.5	1
14	10,000	0.8	1.5	1
15	10,000	0.8	1.5	1
16	10,000	0.8	1.5	1
17	10,000	0.8	1.5	1
18	10,000	0.8	1.5	1
19	10,000	0.8	1.5	1
20	10,000	0.8	1.5	1
21	10,000	0.8	1.5	1
22	10,000	0.8	1.5	1
23	10,000	0.8	1.5	1
24	10,000	0.8	1.5	1
25	10,000	0.8	1.5	1
26	10,000	0.8	1.5	1
27	10,000	0.8	1.5	1
28	10,000	0.8	1.5	1
29	10,000	0.8	1.5	1
30	10,000	0.8	1.5	1
31	10,000	0.8	1.5	1
32	10,000	0.8	1.5	1
33	10,000	0.8	1.5	1
34	10,000	0.8	1.5	1
35	10,000	0.8	1.5	1
36	10,000	0.8	1.5	1
37	10,000	0.8	1.5	1
38	10,000	0.8	1.5	1
39	10,000	0.8	1.5	1
40	10,000	0.8	1.5	1
41	10,000	0.8	1.5	1
42	10,000	0.8	1.5	1
43	10,000	0.8	1.5	1
44	10,000	0.8	1.5	1
45	10,000	0.8	1.5	1
46	10,000	0.8	1.5	1
47	10,000	0.8	1.5	1
48	10,000	0.8	1.5	1
49	10,000	0.8	1.5	1
50	10,000	0.8	1.5	1
51	10,000	0.8	1.5	1
52	10,000	0.8	1.5	1
53	10,000	0.8	1.5	1
54	10,000	0.8	1.5	1
55	10,000	0.8	1.5	1
56	10,000	0.8	1.5	1
57	10,000	0.8	1.5	1
58	10,000	0.8	1.5	1
59	10,000	0.8	1.5	1
60	10,000	0.8	1.5	1
61	10,000	0.8	1.5	1
62	10,000	0.8	1.5	1
63	10,000	0.8	1.5	1
64	10,000	0.8	1.5	1
65	10,000	0.8	1.5	1
66	10,000	0.8	1.5	1
67	10,000	0.8	1.5	1
68	10,000	0.8	1.5	1
69	10,000	0.8	1.5	1
70	10,000	0.8	1.5	1
71	10,000	0.8	1.5	1
72	10,000	0.8	1.5	1
73	10,000	0.8	1.5	1
74	10,000	0.8	1.5	1
75	10,000	0.8	1.5	1
76	10,000	0.8	1.5	1
77	10,000	0.8	1.5	1
78	10,000	0.8	1.5	

Files	A/C Type	A/C #	Date	TD Time	Fly Time
1					
2					
3					
4					
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6					
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Archer — E-864  
Bogard — E-1050

**MANUSCRIPT**

**1. Affix**

**THE**  
**WALL**

10/1/74

6) Networks

100-443886-1

3-11 C00

714 4703

**Book 42**

27-11-2023

## 2. Exercises

70238

1111

2

561 4468

2:48 24th

**15 SEP 1969**

11:09 9 59TH

**Page 2**

**Escape Act**

44-38861-1000

\_\_\_\_\_

**NOTES:** Describe key factors for each assignment.

#1 - Defender started turn 2 Approx 6-7000' High  
Y-6 initiated but defender left area and called  
off pass.

#2 Just a tracking situation - Slight 30-Yds use Nose up and down approximately 20°  
Some tracking pass to cut off defender. Kill would be a probable. Range estimation 3000-2500 with defender increasing range.

#3 Both Hi speeds to speed utilized. When to ponder started A "Roll over" Power was reduced, noise raised and a long trading situation occurred. Range, 1500-1800.

# Same as above except @ lower alt and lower A/S. Both W-4's speed 60-On utilized. Defender rolled under thru the minefield. But as he slowed down a good tracking situation developed. Range 1500-1000.

Note: Defendant sent wrong A.P. until approx. 2000' range.

**CONFIDENTIAL**





413

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NOTE: DATA - THE MESSAGE IS - NOT L(2) X  
 (Fill in blanks; cross out inapplicable entries)

Pilot	A/E	A/E	Date	20 Time	715 Time
Attacker					
Defender					
Engagement #					
1. Attacker	1	2	3	4	5
Type Aircraft	711	11/11	3/11/11		
Initial Speed/Altitude	115/35	11/20	11/20		
Terminal (300') Speed/Altitude	110/35	9/20	110/20		
High Speed Y=70	Yes	Yes	Yes		
Roll off	Yes	Yes	50/11/20		
Low Speed Y=70	No	Yes	-		
Can Kill?	No	No	No		
2. Defender (Initial Speed/Altitude)	115/35	330/20	330/20		
High Speed Y=70	Yes	Yes	Yes		
Roll off	Yes	Yes	Yes		
Low Speed Y=70	-/40	-/23	330/20		
Can Kill?	Yes	Yes	Yes		
3. Attacker Out Shot					
Speed/Altitude					
Can Kill?					
4. Defender Out Shot					
Speed/Altitude					
Can Kill?					
5. Attacker Out Shot					
Speed/Altitude					
Can Kill?					
6. Defender Out Shot					
Speed/Altitude					
Can Kill?					

\* Gun kill but only because the defender misjudged attacker's range before "breaking" to counter the attack.

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413

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2. E.M. DATA

Pool Results Altitude Max Level Max 6 A/E

NOTES: Describe key factors for each engagement.

- #1 Attacker zoomed off too late after attempting to track. Defender could not zoom as high but forced attacker to dump it and run. Before the runaway, the attacker was forced to roll under the defender almost got a kill before the 105 ran away.
- #2 Pressed the attack pulling 105's but couldn't track even 60g so I yep'd high at about 11M. The 86 did a roll eight in behind me & got a kill (I could have probably gotten away but I did not run & the 86 got me).
- #3 The 105 attacker pulled off earlier in the course of pursuit & tried me. Ye-Yes then ran & easily got away by not staying longer in the 86's envelopment.
- Remarks: 105 attacker didn't get 12M but got close enough to it to see what we still cannot track him in the break, it was cannot press the attack at all if we are to get away safely after giving up on the attack.

44.

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EX-107-1 - 2nd Mission 107 - 457 107  
(Fill in blanks; cross out inapplicable entries)

Pilot A/C Type 3105D A/C # 2-86 Date 10/24/68 TO Time 11:00 FTZ Time 11:00

1. Attacking

Type Attack

Initial Speed/Altitude

Terminal (1X/0.1) Speed/Altitude

High Speed Yes/No

Roll Off

Low Speed Yes/No

Gun Kill?

2. Ejector Seat (Initial Speed/Altitude)

Break

Attacker Over Shot

Speed/Altitude

Missiles, # Released

High G Roll Over

Recovery Speed/Altitude

High G Roll Under

Recovery Speed/Altitude

Escape Achieved?

Gun Kill?

2. Ejector Seat

Pool Number

Altitude

Roll

Level Max 6

A/C

3. Descriptive key factors for each engagement.

Attacker's Comments:

1. High Up - No - Jan late and not effective. 3-86  
recovered and got behind.  
2. High Up - No - Jan late and not effective. 3-86  
recovered and got behind.  
3. High Up - No - Jan late and not effective. 3-86  
recovered and got behind.  
4. High Up - No - Jan late and not effective. 3-86  
recovered and got behind.  
5. High Up - No - Jan late and not effective. 3-86  
recovered and got behind.  
6. High Up - No - Jan late and not effective. 3-86  
recovered and got behind.  
7. High Up - No - Jan late and not effective. 3-86  
recovered and got behind.  
8. High Up - No - Jan late and not effective. 3-86  
recovered and got behind.  
9. High Up - No - Jan late and not effective. 3-86  
recovered and got behind.  
10. High Up - No - Jan late and not effective. 3-86  
recovered and got behind.

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45.

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3. LAUNCH  
Pool Number \_\_\_\_\_ Altitude \_\_\_\_\_ Mach \_\_\_\_\_ Level Max G \_\_\_\_\_ A/C \_\_\_\_\_

NOTE: Describe key factors for each engagement.

Attacker's Comments:  
1. Had. Look over but did not get into effective gun range before  
first to break off. Reported. Making close 1. mile and a half  
getting some separation around and moved to try to maintain  
position. Held under about 450 km but was not to turn.  
2. Attempted to track as little longer but could not get  
close enough. Driver went for separation and attempted  
to turn into attack, however, not at distance about 450 km  
but on pass, but had much maneuvering.  
3. Tried to track into fire position. Used 5.5 Gs but could  
not track. Broke off and attempted a reversal with  
defender. No success, so I pass.

45.

THIS DATA - THE NUMBER 837 - ACT 1.2  
(Fill in blank; cross out inapplicable entries)

File	A/C Type	A/C #	Date	TD	TD	TD	TD	TD	TD
Attacker	2405E								
Defender	286								
Maneuver Log									
1. Altitude									
Type Attack									
Initial Speed/Altitude									
Turns (X/G's) Speed/Altitude									
High Speed To-Go									
Roll-Off Potential									
Low Speed To-Go									
Gun Kill									
2. Estimate (Initial Speed/Altitude)									
and Head Turn									
Attacker Over Head									
Speed/Altitude									
Separate, & Re-engage									
High G Roll Over									
Recovery Speed/Altitude									
High G Roll Under									
Recovery Speed/Altitude									
Escape achieved?									
Gun Kill									

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48

48

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TEST DATA 2 - THE MISSING 017 - ACT 2/3/82  
(Fill in blank; cross out inapplicable entries)

Attacker: F-105-D  
Defender: F-84H  
Remarks: See Remarks

File No.	A/C Type	A/C #	Date	TO Time	FLY Time
1. Attacker	Type Attack	Initial Speed/Altitude	Terminal: (Missile) Speed/Angle Off	Target Roll Attack	Missile Kill? Range G Angle Off
2. Defender	Initial Speed/Altitude	Terminal: (Missile) Speed/Angle Off	Target Roll Attack	Missile Kill? Range G Angle Off	Terminal: (Missile) Speed/Angle Off
3. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
4. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
5. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
6. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
7. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
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14. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
15. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
16. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
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44. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
45. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
46. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
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49. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
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66. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
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87. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
88. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
89. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
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99. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated
100. High Speed Y-to-Y	Roll Off	Low Speed Y-to-Y	Gun Kill?	Hard Turn/Break	Missile Attack Defeated

High 'G' Roll Under  
High 'G' Roll Over  
Yes

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2. Remarks  
Fuel Remains  
Altitude  
Mach  
Landing/Man G  
M/G

Notes: Describe key factors for each engagement.  
#1 Attacker initiated high mach descending spiral attack. Defender missed pre-bracketed terminal missile (2 NM range) but did not begin break until after gun kill. Break caused attacker to immediately overshoot. Attacker rolled opposite to inverted and began spiraling supercruise escape. Defender performed high G roll under in anticipation of attacker overshoot & downward escape but attacker achieved separation. #2 Attacker initiated steep G turn; defender lost sight of attacker after missile kill. Attacker pulled into defender's turn but lost overshoot. Speed doing this did low speed roll & closed to defender's low back position for kill. Defender observed attacker at 100' and did an immediate high G roll over, forcing attacker overshoot and obtained gun kill. From 250-1000 range, an attacker attempted escape. #3 Both A & D lost sight of each other several times due to maneuvering distance & clouds. After initial head on pass, attacker zoomed then rolled under for cut off supercruise low speed (1000). After 200/1000, attacker was 700' above & behind Df. who had lost sight of him. Att. had 180 CAS so dropped nose for similar missile launch then dove for escape velocity. Rather than further down for a gun attempt, since at this point defender spotted him and began low speed climb.



50. CONFIDENTIAL

TEXT DATA 2 - SAC MESSIAH 857 - ACT 2  
CPH 100 blank; some are illegible (red)

Pilot A/C Type Date 20 Time 21 Time

E-10SD

F-86H

Attachment 8					
1	2	3	4	5	6
6H	6/10				
12715	9120				
10/20	9/28				
Yes	No				
No	No				
Yes	Yes				
8/35	8/30				
Yes	Yes				
Yes	Yes				
No	No				
No	Yes				
Yes	No				

NOTES: Describe key factors for each engagement.

F-86 Comments:

#1 - F-86H wingman saw F-105's too late and the hard turn did not force overshoot of #2 - F-105. Defensive split then forced overshoot with #2 on inside of turn. #1 F-86's 40-40 then slid behind #1 F-105 and achieved kill at 2000-1500 ft. #2 F-86 got to 6000 ft on #2 F-105 - did not get a kill because of wing roll (95) even though he was in 3000-2000'. #2 - #1 F-105 started left turn and #1 F-86 cut off for a kill with #2 F-86 in trail. #2 F-86 called a left break because #2 F-105 was maneuvering to my back. I broke up left. #2 F-105 unlabeled and separated. F-105 Comments: Good 105 missile attack at 626 mach. I did a hard turn but not hard enough. #2 closed to a kill on #4. Then #1 closed to get a kill on #4. #2 rolled down. The point is that we could not switch from #4 to #3 on the attack because #2 was holding #4. The sandwich works well though. #2 staying right on the #4 & switching down if #2 can't get a kill going by. The sandwich occurs fast & was easy to perform. If the defender makes a hard turn, not a break, the (105) could not switch as listed because #3 separated from #4, so we had to stay after #4.

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TEST DATA - 2nd Mission 517 - 421031  
 (Fill in blanks; cross out inapplicable entries)

CONFIDENTIAL

Pilot: A/C Type: F-86H Date: 10 Nov 51 Fly Time: 1.000  
 Attacker: F-86H  
 Defender: F-100

Engagement		1	2	3	4	5
1. Attacker	2. Defender	1. 86H	2. 86H	3. 100D	4.	5.
Type Aircraft		51H	51H	51H		
Initial Speed/Altitude		85/35	85/30	90/30		
Terminal: (3000') Speed/Altitude		30H	25H	—		
High Speed Yes-No		Yes	Yes	Yes		
Roll Off		Yes	Yes	No		
Low Speed Yes-No		Yes	Yes	No		
Gun Alt?		Yes	Yes	No		
2. Defender (Initial Speed/Altitude)		85/35	85/30	85/30		
Speed		Yes	Yes	Yes		
Altitude		Yes	Yes	No		
Roll Off		Yes	Yes	No		
Low Speed Yes-No		Yes	Yes	No		
Gun Alt?		Yes	Yes	No		
3. Attacker Over Shoot		Yes	Yes	No		
Speed/Altitude		Yes	Yes	No		
Roll Off		Yes	Yes	No		
Low Speed Yes-No		Yes	Yes	No		
Gun Alt?		Yes	Yes	No		
4. Attacker Over		Yes	Yes	No		
Speed/Altitude		Yes	Yes	No		
Roll Off		Yes	Yes	No		
Low Speed Yes-No		Yes	Yes	No		
Gun Alt?		Yes	Yes	No		
5. Attacker Speed/Altitude		Yes	Yes	No		
High C Roll Under		Yes	Yes	No		
Recovery Speed/Altitude		Yes	Yes	No		
High C Roll Under		Yes	Yes	No		
Recovery Speed/Altitude		Yes	Yes	No		
Escape Achieved		Yes	Yes	No		
Gun Alt?		Yes	Yes	No		

NOTE: Describe key factors for each engagement.

#1 - Able to Force F-86H to Overshoot in vertical plane, but F-86 pulled up out of fight & rolled off behind F-100.  
 #2 - Ditto  
 #3 - He Speed 120 lb attempted when F-100 unable to stay in F-86H plane of flight. F-86 able to pull up and shoot down F-100 then roll off to a position behind F-100. F-100 made 95 diving spiral for separation.

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63

63

CONFIDENTIAL

TEST DATA - 245 HISSON 217 - ACT 1.2.3  
(Fill in blanks, cross out inapplicable entries)

7116: A/C Type: F-100 72 Time: 25604

Attacker: F-100  
Defender: F-100

Maneuver Log

1. Altitude

2. Altitude

3. Altitude

Initial Speed/Altitude

Turnout: (X)000 Speed/Altitude

High Speed Y-to-Y

Roll Off

Low Speed Y-to-Y

Gun Altitude

2. Reference (Initial Speed/Altitude) 1.2.3  
3.000 / 17000 TURN

Altitude Gun Shot

Speed Altitude

Altitude, 0 Altitude

Altitude Gun Shot

Altitude Speed/Altitude

Altitude Gun Shot

Altitude Speed/Altitude

Altitude Gun Shot

Altitude Gun Shot

SURTS: Describe key factors for each maneuver.

#1 Brake off attack & climbed away when unable to track.

#2 Unable to track - F86 broke left.

#3 Spooked when F86 broke.

#4 Tracked to 2000' in hard turn - then F86 broke.

#5 Pulled up & rolled off about 100' behind.

S6 - S6 pulled 100' into vent. rolling.

scissors 100' dove away starting at 2000'. S6 able to achieve gun kill.

#6 Tracked to 1700' in hard turn then S6 broke harder.

Note: in dive away 100' waggled wings & fishtailed which frustrated S6 from tracking.

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REF/REF - THE REVISION (S) - ACT L (S)  
(Fill in blank: cross out inapplicable entries)

Attacker \_\_\_\_\_ Pilot \_\_\_\_\_ A/C # \_\_\_\_\_ Date \_\_\_\_\_ TO Time \_\_\_\_\_ Fly Time \_\_\_\_\_  
Defender \_\_\_\_\_ F-100  
Remarks \_\_\_\_\_ F-86

1. Altitude  
Type Attack  
Initial Speed/Altitude  
Terminal (3000') Speed/Altitude  
High Speed Y-to  
Roll Off  
Low Speed Y-to  
Gun Kill?

2. Ref/Ref (Initial Speed/Altitude)  
Area/Head/Fail  
Attacker Over Shot  
Speed/Altitude  
Sensors, & Reversals  
High G Roll Over  
Recovery Speed/Altitude  
High G Roll Under  
Recovery Speed/Altitude  
Escape Achieved?  
Gun Kill?

Engagement #		1.	2.	3.	4.	5.
1.	7/11	7/11	6/20	6/20	6/20	6/20
2.	8/35	8/30	8/30	8/30	8/30	8/30
3.	9/10	9/30	9/30	9/30	9/30	9/30
4.	No	No	No	No	No	No
5.	No	No	Yes	No	No	No
6.	No	No	No	No	No	No
7.	Yes	Yes	Yes	Yes	Yes	Yes
8.	8/30	9/25	9/25	9/25	9/25	9/25
9.	Yes	Yes	Yes	Yes	Yes	Yes
10.	Yes	Yes	Yes	Yes	Yes	Yes
11.	7/30	7/30	7/30	7/30	7/30	7/30
12.	Yes	Yes	Yes	Yes	Yes	Yes
13.	No	No	Yes	Yes	Yes	Yes
14.	-	-	Yes	Yes	Yes	Yes
15.	No	No	No	No	No	No
16.	-	-	-	-	-	-
17.	No	No	No	No	No	No
18.	No	No	No	No	No	No

NOTES: Describe key factors for each engagement.  
#1- F-86 used hard turn instead of break due to underestimation of F-100's speed/altitude. Max power F-100 reacted to by overshoot and effectively drove for separation.  
#2- F-86 used hard turn up to vertical. F-100 tracked the low overshoot & effectively drove for separation.  
#3- F-86 climbed hard up. F-100 tracked to 200' overshoot - high. F-100 attempted another pass from 300' to 50' but F-86 turned hard into situation and achieved maximum overshoot. F-100 effectively drove for separation.  
#4- F-86 broke, F-100 dissipated energy unable to trace - F-86 did hi G roll and maneuvered to F-100's back. F-86 turned so through entire drive for separation.

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TEST DATA - SAC MESSAGE 057 - AC 3 2  
(Still in blanking area not applicable action)

File # \_\_\_\_\_ A/C # \_\_\_\_\_ Date \_\_\_\_\_ 20 Time \_\_\_\_\_ 21 Time \_\_\_\_\_  
Attacker \_\_\_\_\_ F-86H  
Defender \_\_\_\_\_ F-105

Initiator		1	2	3	4	5
1. AIRCRAFT						
Type Aircraft		6/44	5/44	6/44		
Initial Speed/Altitude		85/29	85/29	95/31		
Turn Rate: (Degrees) Speed/Altitude		92/20	95/20	95/25		
Barrel Roll Attack		Yes(2)	No	No		
Missile Kill? Range 6 to 10 000		No	No	No		
Turn Rate: Gun Attack (2000 ft)		Weak	Weak	Weak		
High Speed No-Go		No	No	No		
Roll Off		No	No	No		
Low Speed No-Go		No	No	No		
Gun Kill?		Yes	Yes	Yes		
2. DEFENSE - Initial Speed/Altitude		85/26	97/24	94/23		
Hard Turn/Brake		Yes	Yes	Yes		
Missile Attack Deflected		Yes	Yes	Yes		
Barrel Spiral		No	No	No		
Vertical Rolling Maneuvers		No	Yes	No		
Accelerator Over Shock Speed/Altitude		20/32	20/42	No		
Escape Achieved?		N/A	No	N/A		
Gun Kill?		No	No	No		

NOTES: Descriptive key factors for each engagement.

Defenses: #1 - Defender did not attempt to achieve the  
mach advantage. From 9B attack pulled off 1st & then 2nd  
causing attacker to exceed angle off 1st & then 2nd  
limit. If attacker is deflected inside max range, escape  
will be difficult. If 100 turns with max mach, 800  
can cut off & prevent F-105 from achieving separation.  
If straight ahead segment is attempted, this will  
increase chance of missile kill. Follow up gun  
attack - Attacker tracked from 3000 - 800'. Consequently  
over shot slightly with defender @ 1000'. Defender  
unable bring pipper up to 1000' because air speed. Had  
dropped to 1000' kts. #2 start same as #1 - but Def had  
92 M. Attacker took longer to close. Following gun attack  
successful. Eventual over shot @ 800'. Into stalemate.  
Unstable rolling scissors. When def disengaged &  
attempted to achieve longit. separation he was  
shot down again. (H. could have achieved overshoot by using  
hi speed 1000' kts. #3 1000' from 9B. Defender  
countered 2nd attack with hard turn. Defender  
break. 1st attacker reached 2000'. Attacker used 1st  
Dead weight to position for 2nd gun pass. Def. air speed 1000 kts.  
#4 Above 1000' engagement. 2000' kts. 1000' kts. 900' kts.  
2000' kts. 1000' kts. 1000' kts. 1000' kts. 1000' kts.  
missile range. However 100 turned to allow 86 to close  
(loop) then 100 turned down (60°) spoiling 86's  
tracking solution. Disengagement would have been  
tracking diff. 100.

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TEST DATA 2 - TAC MISSION 837 - ACT 2 (5) 2  
(Fill in blanks; cross out inapplicable entries)

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File # \_\_\_\_\_ A/C Type F-100D A/C # \_\_\_\_\_ Date \_\_\_\_\_ TO Time \_\_\_\_\_ Fly Time \_\_\_\_\_

Attacker \_\_\_\_\_ Defender \_\_\_\_\_

Remarks: E-86H

1. Attacker

Parameter	1	2	3	4	5
Initial Speed/Altitude	1,100	6,140			
Terminal: (Missile) Speed/Angle Off	95/40	5/25			
Barrel Roll Attack	Yes	No			
Missile Kill: Range & Angle Off	No	No			
Terminal: Opp Attack (7000'N)	---	No			
High Speed Yo-Yo	No	No			
Roll Off	No	No			
Low Speed Yo-Yo	No	No			
Gun Kill?	No	No			
2. Defender - Initial Speed/Altitude	85/37	80/25			
Hard Turn/Brake	Yes	Yes			
Missile Attack Defused	Yes	No			
Barrel Roll	No	No			
Vertical Rolling Scissors	No	No			
Attacker Over Shoot: Speed/Altitude	No	Yes			
Escape Achieved?	Yes	Yes			
Gun Kill?	Yes	Yes			

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1. F.M. Time \_\_\_\_\_ Fuel Remains \_\_\_\_\_ Mach \_\_\_\_\_ Altitude \_\_\_\_\_ Level/Name G \_\_\_\_\_ A/C \_\_\_\_\_

Notes: Describe key factors for each engagement.

#1 Attacker lost sight of defender during diving spiral due to low viz.

#2 Attacker unable to press for missile attack - Pressed for gun attack - unable to track - over shot. Defender broke hard, did a high barrel roll and maneuvered to low and achieved a gun kill.

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**3. E.M. Jones**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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#1 - 5000 DEF. F-86H ATT.  
NOTES: Selecting key factors for each engagement.  
#1 - DEF'S SP4T @ 1000'. ATT 1st SWITCHED TO

## Statement of

3.	4.	5.
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7:11 PM	6/20				
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[illegible]

			1	
				1

NO	NO		
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25/5	UNK				
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YES	NO				
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YES	YES
-----	-----

[illegible]

YES	YES
-----	-----

[illegible]

9/30	5/30
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YES	YES
-----	-----

YES	YES
-----	-----

YES	NO				
YES	NO				

[illegible]

11/23	11/23	11/23	11/23
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YES	YES
YES	YES

207	207
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[illegible][illegible]

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ANNEX C

PILOT FLYING EXPERIENCE

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PILOT FLYING EXPERIENCE

<u>PILOT</u>	<u>AIRCRAFT</u>	<u>TOTAL TIME</u>	<u>TOTAL JET</u>	<u>TOTAL UE AIRCRAFT</u>
A	F-86H	4870	2179	1329
B	F-86H	4786	1729	1121
C	F-86H	2493	1386	1059
D	F-86H	2687	1287	987
E	F-86H	3211	1829	1061
F	F-86H	3958	2948	1014
G	F-86H	2624	2184	996
H	F-86H	1083	837	684
AA	F-86H	Unknown	Unknown	Unknown
I	F-100	2674	2334	1936
J	F-100	2786	2505	1313
K	F-100	2088	1838	1695
L	F-105	5097	4142	320
M	F-105	3083	2779	271
N	F-105	2353	2059	272
O	F-105	2708	2450	500
P	F-105	3010	2600	570
Q	F-105	2054	1800	652
R	F-104	2000	1750	750
S	F-104	1600	1500	1100
T	F-104	1500	1400	625
U	F-104	Unknown	Unknown	Unknown
V	F-4C	6300	4000	530
W	F-4C	4600	4100	250
X	F-4C	3600	3000	170
Y	F-4C	4500	3500	600
Z	F-4C	3100	3000	550

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ANNEX D

F-105 ACCELERATION COMPUTATION

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F-105 ACCELERATION COMPUTATION

Using energy maneuverability terms and Ps values obtained from current Ps-V diagrams (APGC-TDR-64-35 & 38) the acceleration times can be approximated in the following manner. The F-105D is shown in the sample computation.

Terms are as follows:

Ps = Energy rate = specific excess power in ft/sec.

Es = Specific energy in feet.

H = Altitude in feet.  $\frac{dh}{dt}$  = rate of climb (ft per sec)

V = Velocity in feet per second.

$\frac{dv}{dt}$  = a = Acceleration in feet per second per second.

g = Gravitational constant.

From energy maneuverability theory:

$$Es = \frac{V^2}{2g} + H$$

differentiating with respect to time (T)

$$\frac{dEs}{dt} = \frac{V}{g} \left( \frac{dV}{dt} \right) + \frac{dh}{dt} = Ps$$

$$\text{or } \frac{dV}{dt} = a = \frac{g}{V} \left( Ps - \frac{dh}{dt} \right)$$

assuming an average acceleration:

$$V = V_0 + at \text{ or } t = \frac{V - V_0}{a}$$

For the first case, assume a .95 mach (1010'/sec) attacker detected by an F-105 at 15,000' and 330 KCAS (.665 mach or 706'/sec). Assuming the attacker has no further mach capability, the F-105 will begin to separate when its velocity has reached .95 mach. We'll assume that the F-105 uses

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a level A.B. acceleration in level flight. Ps values for the F-105 (clean, 5000# fuel remaining) in this area average 300 ft/sec. The average velocity during this acceleration is .8 mach. At 13,000' this is 505 KTAS or 854'/sec.

$$\text{then: } a = \frac{32.2}{854} (300-0) = 11.3'/\text{sec}^2$$

the time to accelerate to .95 is then:

$$t = \frac{V - V_0}{a} = \frac{1010 - 706}{11.3} = 27 \text{ seconds}$$

If the attacker's average rate of closure during this time (t) is .15 mach (.95 - .8) or 156' per second, the attacker covers 4210' during this 27 seconds. Closure at a rate of .285 mach (304'/sec) should also be added for at least 3 seconds to allow for F-105 afterburner light time, allowing the attacker to cover an additional 912'. Hence, if the attacker is to be maintained at a minimum distance of 3000', a level A. B. acceleration must be begun under these conditions before the attacker has closed to 8100'. A  $\frac{1}{2}$  G diving acceleration can be analyzed in the same fashion. Assume an average descent during the acceleration of 6000' per minute (-100'/second). The average Ps for the above conditions under  $\frac{1}{2}$  G loading is approximately 320, hence  $a = \frac{32.2}{854} (320 + 100) = 15.8'/\text{sec}^2$

$$\text{and } t = \frac{1010 - 706}{15.8} = 19.2 \text{ seconds.}$$

During this time, the attacker would close 2990'. Adding the 912' of closure during 3 second A. B. light time, if the attacker is to be maintained at a minimum distance of 3000' then the  $\frac{1}{2}$  G diving acceleration must be begun before the attacker has closed to 7000' range.



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ANNEX E  
PARTICIPATING TEAM  
POST MISSION SUMMARIES

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**F-86H TEAM SUMMARY OF MISSION FF-857**

WRITTEN BY LT/COL JOSEPH J. MAISCH, JR.

1. The F-86H can successfully defend against both missile (AIM-9) and gun attacks by the F-100, F-105, F-104 and F-4 as long as he is aware of their presence before they reach effective firing range. After defending against this gun attack from within 3000 ft range, the F-86H will probably get a gun kill on the F-100 or F-105 (unless the F-105 has .95 mach or better). The F-104 and F-4 can escape in the reversal if their speed is .9 or higher, otherwise, the F-86H stands a chance of a quick gun kill during the F-104 or F-4 separation maneuver. The F-86H has a better chance for a kill if coached, on when to reverse, by a properly positioned wingman (4000 to 5000 abreast or slightly aft).
2. Of the four century types, only the F-100 has any chance at all of escaping the F-86H when fighting the obsolescent ACM game; and this F-100 pilot must be of FWS instructor caliber.
3. The F-100 and F-105 have not been successful in escaping from an F-86H gun attack when the evasive maneuvering was started at 4500 feet or less range. The F-104 and F-4 can escape this attack from as close as 3000 ft range, but only if they start the separation maneuver immediately. The only successful separation maneuver is the one whereby they start an unloaded (+1/4 to 0 G) quarter descending roll, attempting to spoil the attacker's tracking problem by reversing roll direction in the descending plane and using minimum positive G while separating at the maximum possible rate. The F-86H will normally decrease the range by 1000 - 1500 ft while the F-104 or F-4 is performing the initial part

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of the separation maneuver, but will be unable to track if the defender performs properly.

4. The F-104 has a definite advantage in that he is very difficult to acquire visually due to small profile, and once acquired difficult to keep in sight. Also, when the 104 rolls into a bank it is very difficult to determine the direction in which he is turning or will turn. The 104 is extremely difficult to see when making a head-on pass.

5. The F-100 and at times the F-105 can cause the F-86H to overshoot from a stern type pass. The amount of overshoot is of course determined by the closure rate. This overshoot however, is merely a delaying action because the F-86 can yo-yo high, watch the next move by the defender and then either roll over the top or slide down into the 6 o'clock. The F-4 and F-104 cannot normally cause the F-86 to overshoot.

6. The F-86H is capable of pulling up into a "whifferdill" type maneuver to almost zero airspeed without snap type maneuvers resulting, and will then accelerate very well in the downhill run.

7. The F-86H has one very definite limitation in the .91 to .96 range and that is its tendency to roll to the right. This makes rolling to the left very difficult, and tracking during this wing roll is just about impossible.

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**F-104 TEAM EVALUATION OF F-104 VERSUS F-86H**

**1. F-104 Defender, F-86H Attacker:**

a. At almost any range and any reasonable cruise airspeed for that altitude, the F-104 can escape if he does it correctly (regardless of the attacker's range).

b. Never pull up into the attack or try to break or hard turn level as a defensive maneuver.

c. A flaps up, full afterburner, diving low G spiral is an almost fool-proof escape maneuver. It is extremely difficult to track and lateral separation is rapidly attained.

d. If the attacker has closed into 1500 feet and, for some reason, has "missed," he can be forced into an overshoot if he has any appreciable overtake speed. The F-104 will decelerate faster but the overshoot is only momentary and at best gives an opportunity to break down and away as the attacker rolls over the top for repositioning. (Not a useful maneuver in any but a super last ditch attempt to get away from an attacker who has run out of ammo!)

e. Starting a mission at the same time, the F-104 can spar with an F-86H attacker in the trans-sonic region and run the attacker out of fuel.

f. In rolling down and away for separation from an F-86H, it is best to go to the left as this amplifies the attacker's wing roll tendencies and complicates his tracking problem at higher mach numbers (.92+).

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2. F-104 Attacker, F-86H Defender:

a. In attacking with the F-104 the only real offensive strength other than the superior speed is the fact that the F-104 is difficult to see (especially in the headon profile) and it is difficult to judge range and closure rate.

b. If the defender makes a hard turn at ranges of 5000 feet or less the F-104 can make a gun kill before sufficient angle off is generated by the defender. This is providing the attacker is supersonic. At subsonic speeds the attacker is able to track longer but is not able to close into gun range before the large angles off are generated. It is therefore no advantage to slow down to enhance turn radius and tracking time. The escape is about the same since at higher overtake speeds, the defender has generated less turn prior to his reversal; on the lower speed pass, the defender has turned farther so has less airspeed himself and has a larger angle to reverse through before he poses a threat to the attacker.

c. If the defender breaks into the attack at ranges outside of 4000 feet it is not possible to track for a gun kill. The escape is no problem since the defender has lost all airspeed and has generated great angles off.

d. At low altitudes the F-104 can zoom away from any subsequent gun attack after the overshoot but is in a position for a possible missile attack by the defender.

e. If the F-104 does not have to defend against missile attack, it can stay in the combat area and spar with the F-86 making high speed

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attacks against the defender and possibly get a successful gun attack or a surprise deep six attack, if the F-86 loses sight of his attacker. In any case the F-86 could be kept engaged until fuel considerations required the F-104 to leave the fight.

3. (ACT-5) F-104 Defending Element versus F-86H Attacking Element:

The F-104 performed defensive split with the F-86 closing from a stern quartering attack. The defensive split was only effective in that it delayed the final positioning of the F-86. In order for either F-104 to escape both must perform the diving spiral type of escape. The defensive split is not an effective maneuver to perform against the F-86H. If the F-104 defenders are fortunate enough to spoil the attackers at a mile, it is mandatory to immediately dive out of the fight rather than attempt any other maneuver, and then attempt to engage on more favorable terms.

4. F-104 Attacking Element versus F-86H Defending Element:

On ACT-6 we had time for two passes and both passes were run under the same parameters. F-86H at 35000 feet and .88 mach, the F-104 at 35000 feet and .90 mach. The attack was initiated from 4 o'clock position about five miles out.

We discounted the value of element close formation tactics so on the initiation of the attack the wingman slid out about 30 degrees from the lead and did a max acceleration low G run on this heading. The lead attacker began a slow turn flying a pursuit curve and accelerated to .98. As the lead closed in to about a mile the number two attacker commenced his turn in. Shortly thereafter the defenders did a defensive split.

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They performed it perfectly with the #2 defender calling the reversal as the attacker overshot. Since the wingman was obviously pulling less G's he was tracked for a few moments before the F-104 was forced to break off in the overshoot. The lead defender immediately reversed and the wingman rolled under but the attacking F-104, with approximately .95 mach, spiraled down and to the left with no real difficulty in achieving separation. About this time the #2 attacker made his tracking pass and had a clear shot at either defender. He then pulled off and rejoined lead.

During this attack the defenders were unable to pick up the attacking lead until he was in about one mile. He therefore called off his range and angle off. They never did pick up the number two man.

After the breakaway the lead F-104 pulled up sharply about a mile ahead of the pursuing F-86's and at 1.3 mach. Within 30 seconds the F-86's were in gun range and tracking on the zooming F-104. This confirmed earlier findings that after accomplishing a successful escape maneuver it is unwise to zoom up and try to return immediately to the combat area.

On the second pass the same results were achieved, however, the attackers did not get enough lateral separation and the #2 attacker was in the attack too early and had little time to track, if any. He did distract the defenders and caused them to lose sight of the lead attacker who had commenced his dive for separation. On observing the defenders' reverse back after the #2 attacker, the lead rolled out and zoomed back

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up immediately into the six o'clock of the defending flight. As he was completely unobserved he had no evasive action to contend with at this time.

On both attacks the attack would have been enhanced had the lead attacker accelerated to 1.05 or 1.1. A speed differential of .35 between the two attackers is just a little too much and a supersonic pass from any quarter was found earlier to be most advantageous for the attacker.

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**SUMMARY OF THE F-4C PORTION OF TAC MISSION FF-857**

Program FF-857 was established to determine optimum offensive and defensive tactics for the F-4C when confronted with highly maneuverable, but subsonic aircraft of the MIG 15/17 type. Air National Guard F-86Hs were the closest available approximations to the desired maneuvering and performance characteristics and were used as adversaries throughout the evaluation. The specifics of the program were defined by the USAF Fighter Weapons School, under the direct supervision of Colonel James C. Hare, Commandant, with Captains Muskat and Williams as project officers. Three F-4Cs with five pilots, one maintenance officer, and fourteen maintenance support personnel were provided by the 4453 CCTW for the period 2 May - 7 May at Nellis AFB, Nevada. Lt Colonel R. S. Parr commanded the F-4C detachment and functioned as F-4C project liaison with the Fighter Weapons School.

The Evaluation as planned by the fighter weapons project officers required sixteen flights, broken down as follows:

- |                      |  |
|----------------------|--|
| Air Combat Tactics I | - F-86H vs F-4C (Gun Attack)             |
| (3 Sorties)          |  |
| ACT                  | II - F-4C vs F-86H (Gun Attack)          |
| (3 Sorties)          |  |
| ACT                  | III - F-86H vs F-4C (Missile Attack with |
| (3 Sorties)          | Follow-up Gun Attack)                    |
| ACT                  | IV - F-4C vs F-86H (Missile Attack with  |
| (3 Sorties)          | Follow-up Gun Attack)                    |
| ACT                  | V - 2 F-86H vs 2 F-4C (Evaluate Element  |
| (2 Sorties)          | Defensive Tactics against Gun Attack)    |
| ACT                  | VI - 2 F-4C vs 2 F-86H (Evaluate Element |
| (2 Sorties)          | Offensive Tactics for a Gun Attack)      |

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There was allowance for additional sorties, if needed, to further validate or investigate findings on any of the previously flown sorties.

As flown the project required eighteen sorties, the two additional flights were to further substantiate the findings on ACT I and ACT III. ACT V and VI were combined and accomplished on the final flight because the F-86s were forced to air abort on ACT V when one of their aircraft experienced a minor emergency on climb out.

SUMMARY BY MISSION TYPE

**ACT I:**

a. With the F-4C simulating Combat Air Patrol at 35,000', .85M, the attacker closes to approximately 4,000-5,000 feet, 10°-15° angle off, at .94-.97M prior to any defensive maneuvers by the F-4C.

(1) The most consistently successful escape was achieved by pushing to approximately 0 to  $\frac{1}{2}$  "G", simultaneously advancing to maximum power while rolling approximately 60° bank angle into the attacker. This resulted in a rapid acceleration to co-speed while the attacker closed an additional 1,000' to 1,200' then an ever increasing separation to well out of effective gun range. The length of time at 0 to  $\frac{1}{2}$  "G", thus allowing maximum acceleration, is a function of aircraft limitations, attacker range at initiation and attacker closing rate.

b. F-4C simulating cruise with load at 20,000', .78M, otherwise same as previous encounter.

(1) Essentially the same as 35,000', but it is imperative that any high drag/heavyweight stores should be dropped immediately. Additional measures such as rolling or "jinking" while separating from attacker would severely limit his ability to track at long range.

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**ACT II:**

a. F-86H at 35,000', .83M, F-4C initiates stern quarter gun attack, F-86 commences evasive maneuvers at 4,000-5,000' attacker range.

(1) Although the F-4Cs were on the offensive for this mission, the F-86s were tasked with: 1. escaping, and 2. attempting a gun or heat missile attack when and if the F-4Cs overshoot.

If the F-86s initiated proper evasive maneuvering well prior to F-4C gun range they invariably escaped. If they misjudged closure rates and delayed their evasive maneuvering or reversed too soon on anticipated overshoot, they could be tracked and probably destroyed. It was imperative for the F-4s to keep their mach up throughout the attack to achieve escape after overshooting. If the F-4 slowed and attempted to maneuver with the F-86, they were extremely vulnerable. The optimum mach for the F-4s appeared to be approximately 1.0-1.1M. This kept closure rates to a reasonable value, and still allowed either a successful maximum afterburner climbing departure or quarter roll descending break when tracking was no longer practical. In this phase, mach must not be sacrificed in attempts to out-maneuver the adversary.

b. F-86 at 20,000', .8M, F-4C initiates stern quarter gun attack. F-86 commences evasive maneuvering at 4,000-5,000' attacker range.

(1) Same comments as above.

**ACT III:**

a. F-4C at 35,000', .85M simulating CAP. F-86H initiates stern quarter heat missile and follow-up gun attack. F-4C defensive maneuvering starts when attacker at 6,000-7,000 foot range.

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(1) This is by far the most difficult attack to thwart. To defeat the missile attack it is necessary to turn into the opponent, to defeat the gun attack requires separation. A level, or nose high, maximum afterburner, hard turn into the attackers would preclude a successful missile attack but would permit closure and a successful gun attack. The optimum defensive tactic appeared to be an immediate, nose low, maximum afterburner turn into the attacker. Approximately 30° nose down with not more than three "G" initially would allow acceleration, but still shrink the missile envelope enough to defeat the missile attack, while the acceleration effectively separated from the F-86 and precluded a successful gun attack. A further roll reversal underneath achieved maximum separation rate, but did not seem to be necessary. Premature zooms, after initially escaping, would probably result in a successful missile or gun kill by the opponent if he pressed the attack.

b. F-4C at 20,000', .78M simulating heavyweight cruise. F-86 initiates stern quarter heat missile and follow-up gun attack.

(1) Same as above, but the reduced altitude preclude any steep accelerating, moderate "G" roll unders after the initial phase.

**ACT IV:**

a. F-86 at 35,000', .82M, F-4C initiates heat missile attack from stern quarter with follow-up gun attack.

(1) Essentially the same as ACT II. Barrel roll attacks for an optimum heat missile launch were attempted, but the superior maneuverability of the F-86, and the extremely limited capabilities of the Sidewinder against a maneuvering target precluded success.

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**ACT V:**

a. Two F-4s simulating CAP at 35,000', .86M; two F-86s initiate stern quarter gun attack. F-4s commence defensive maneuvering at approximately 4,000-5,000'.

(1) For adequate mutual support it is essential for the defenders to maintain line abreast. Early recognition of the attackers as to type, range and closure rate allowed adequate defensive maneuvering to preclude a successful gun attack.

**ACT VI:**

a. Two F-86s simulating cruise at 35,000', .82M; two F-4s attack from stern quarter.

(1) Essentially the same as ACT II. Because of the mutual support aspect of this mission it is feasible to press the attack further. Optimum element tactics could not be established on the basis of a single flight.

**GENERAL COMMENTS:**

In preparation for the evaluation, the team leader initiated discussions among the F-4 pilots to establish principles and compare capabilities of the F-4 and F-86H. Although specific performance and maneuvering data were not available for the F-86H, experience verified by rough calculation immediately established the decided maneuvering advantage of the F-86 at indicated speeds of 400K and below, and at the altitudes to be used for the program this was the applicable envelope. This was translated into the first principle:

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(1) It is pointless to attempt outturning the F-86 with the F-4C as presently configured. It is conceivable, however, that a supplemental lift device could improve the F-4C's turn capability and make it competitive with the F-86.

Since the F-4C cannot out-maneuver the F-86, the second principle logically followed:

(2) When attacked, the F-4C should immediately strive for separation and re-enter the flight on its own terms.

The performance comparison included the obvious fact that the F-86 was mach limited to approximately 1.0, and then only in a steep dive. Further discussion and calculation indicated a decided advantage in thrust to weight ratio in favor of the F-4C. This fact has to be tempered with drag considerations, since excess thrust to weight ratio determines performance capabilities. This ratio is greatest at the best climb speed for any given altitude, which closely approximates .9M for the F-4C in the configuration and at the altitudes flown. In view of the drag characteristics associated with low aspect ratio, high wing loaded aircraft, any maneuver which increases lift greatly increases drag and therefore decreases excess thrust.

It logically follows that any actions which maximize excess thrust assist in achieving the desired separation. If the aircraft is "unloaded" to 0 to  $\frac{1}{2}$  "G", drag is minimized, excess power increases and maximum separation rate is achieved. If it is essential to turn into the opponent to defeat a missile attack "G" must be applied sparingly and the nose allowed to drop (at medium and high altitudes) to

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allow acceleration and thus separation. Operation at M below that for best climb represent a loss in efficiency, allow the attacker to close further and increase the speed differential, thus time thru which the defender must accelerate. This leads to the last principle:

(3) Keep your mach up.

The higher your initial mach, the less closure rate for the attacker, and the more time available for sighting and/or maneuvering.

The flights conducted throughout the program indicated several areas for further development or investigation.

a. The Sidewinder (AIM-9/B) is severely limited when employed against a maneuvering target.

b. There is a definite need to develop Sparrow III employment tactics against maneuvering target without a GCI environment; the range capabilities of the missile greatly exceed the visual identification envelope.

c. Aft visibility from the F-4C is severely restricted by the "flush" canopy design. Removal of the aft cockpit instrument hood assists slightly, and the installation of mirrors in the aft cockpit also assists, but even with these changes it is still very poor.

d. A lift supplement, such as maneuvering flaps, could greatly increase the ACM potential for the F-4C.

e. The trim change gradient associated with airspeed changes, and the relatively slow trim response of the F-4 make maximum performance maneuvering difficult.

f. Currently established flight tactics should be thoroughly reviewed and validated.

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g. If the F-4 is to be employed as an air superiority weapon, a moduled gun and a pilot controlled computing sight are essential.

h. If the roll damper in the F-4 is not precisely adjusted, it can cause unnecessary tracking difficulties. A pilot selected roll damper would eliminate this limitation.

i. The automatic shoulder harness lock installed in the Martin Baker seat severely limits pilot mobility when maneuvering. Again, a selective cutout of this feature would be highly desirable.

j. The almost complete lack of a vigorous ACM program throughout the Air Force severely limits our potential. ACM takes practice and judgement, proficiency cannot be achieved by reading manuals and theorizing. The risks inherent in maximum performance maneuvering can be minimized by education and supervision. Unrealistic limitations would defeat the fundamental purpose.

k. The scope of TAC Program FF-857 was too limited. ACT against like aircraft, simulating MIG 19, MIG 21, etc. should have been included.



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ANNEX F

ACT MANEUVER DIAGRAMS  
AND  
EXPLANATION

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ACT MANEUVER DIAGRAMS AND EXPLANATION

1. HIGH SPEED YO-YO (Figure 1)

The high speed yo-yo is an offensive maneuver in which the attacker maneuvers through the vertical and horizontal planes to prevent an overshoot in the plane of the defender's turn. When an overshoot appears imminent, the attacker pulls up into vertical plane, so that nose tail separation can be maintained. Afterburner should be employed as required (especially in F-105) to maintain some closure. At the slower speed in the apex, a turn is made to realign with the defender's 6 o'clock position.

2. LOW SPEED YO-YO (Figure 2)

The low speed yo-yo is an offensive maneuver which provides turn cut-off and closure speed in a Lufberry turn, or increased closure rate in a running battle. To gain position quickly, with this maneuver, the attacker lights the afterburner and dives below and inside the defender's flight path, and then pulls up to zoom at the defender and either pulls into his turn, or executes a follow up high speed yo-yo if the angle off is too high.

3. THE SCISSORS MANEUVER (Figure 3)

The scissors is a defensive maneuver in which a series of turn reversals is executed in an attempt to achieve an offensive potential after an overshoot by an attacker. Success, when employing the scissors maneuver, depends on the defender's ability to achieve a lower velocity component in the direction of the flight, using a large amount of turning and rapid speed reduction.

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### 4. VERTICAL ROLLING SCISSORS (Figure 4)

The vertical rolling scissors is a defensive maneuver which is used when a defensive turn in the vertical plane causes the attacker to overshoot. The defender then reverses into the attacker, and continues a high G rolling maneuver to force the attacker out front.

### 5. BARREL-ROLL ATTACK (Figure 5)

This offensive maneuver can be effectively employed when approaching a defender at high angle off and long range. If a high speed yo-yo is employed under these circumstances, the attacker is forced to an extremely high apex in order to maintain nose-tail separation and stay inside the defender's turn radius. The barrel-roll attack allows the attacker to reduce his velocity, cut-off and turn inside the defender's turn, then regain velocity after angle off is diminished.

### 6. HIGH G BARREL-ROLL (Figure 5 & 6)

The high G barrel-roll is a "last ditch" defensive maneuver which is used to force the attacker out front. The maneuver is a max performance, vector roll designed to rapidly reduce aircraft indicated airspeed and vector velocity. The roll can be made in the direction of the turn (under) or following a reversal (over). The high G barrel-roll over the top is performed if an attacker is detected with low rate of closure at gun range, and the defender knows that a break would not be successful. The maneuver requires a high angle of attack capability at slow speed and is generally not suitable for F-104 type (high horizontal tail surface) aircraft. For the F-105, since control response is sluggish and airspeed bleed off rapid, the maneuver is not recommended. The high G roll under

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is performed if low airspeed does not permit execution over the top, and as a last ditch maneuver for F-105 aircraft. In the F-105 aircraft, rapid speed bleed off plus an approximate 5000' altitude loss will result. The high G roll under is entered with a rapid roll to the inverted position.

7. DIVING SPIRAL (Figure 8)

The diving spiral is performed as a last ditch maneuver designed to prevent gun or AIM-9/B type missile kill while the defender is gaining airspeed for separation, or to perform a reversal up into the attack. Entry to the diving spiral is similar to the high G roll under. From the inverted position the aircraft is pulled into a vertical spiral or a spiral with a lesser axis of descent, depending on altitude available. Max power is used and moderate G is combined with a rapid roll rate to defeat the attacker's tracking. The increasing airspeed will increase both acceleration and G capability. As airspeed builds, G is relaxed to allow further airspeed increase for separation.

8. DEFENSIVE SPLIT (Figure 9)

The defensive split is performed if an element is attacked and cannot achieve separation or turn to meet the attack. A defensive turn is held to defeat the AIM-9/B type missile attack. As the attacker(s) close for a gun attack, the defending element leader calls the split as the attackers approach gun range. The low defender continues a hard turn or increases to a break as required and the high defender slides high to acquire a line abreast position in the vertical and horizontal plans, with about 3000-4000' separation. The object is to force the attacker(s) to

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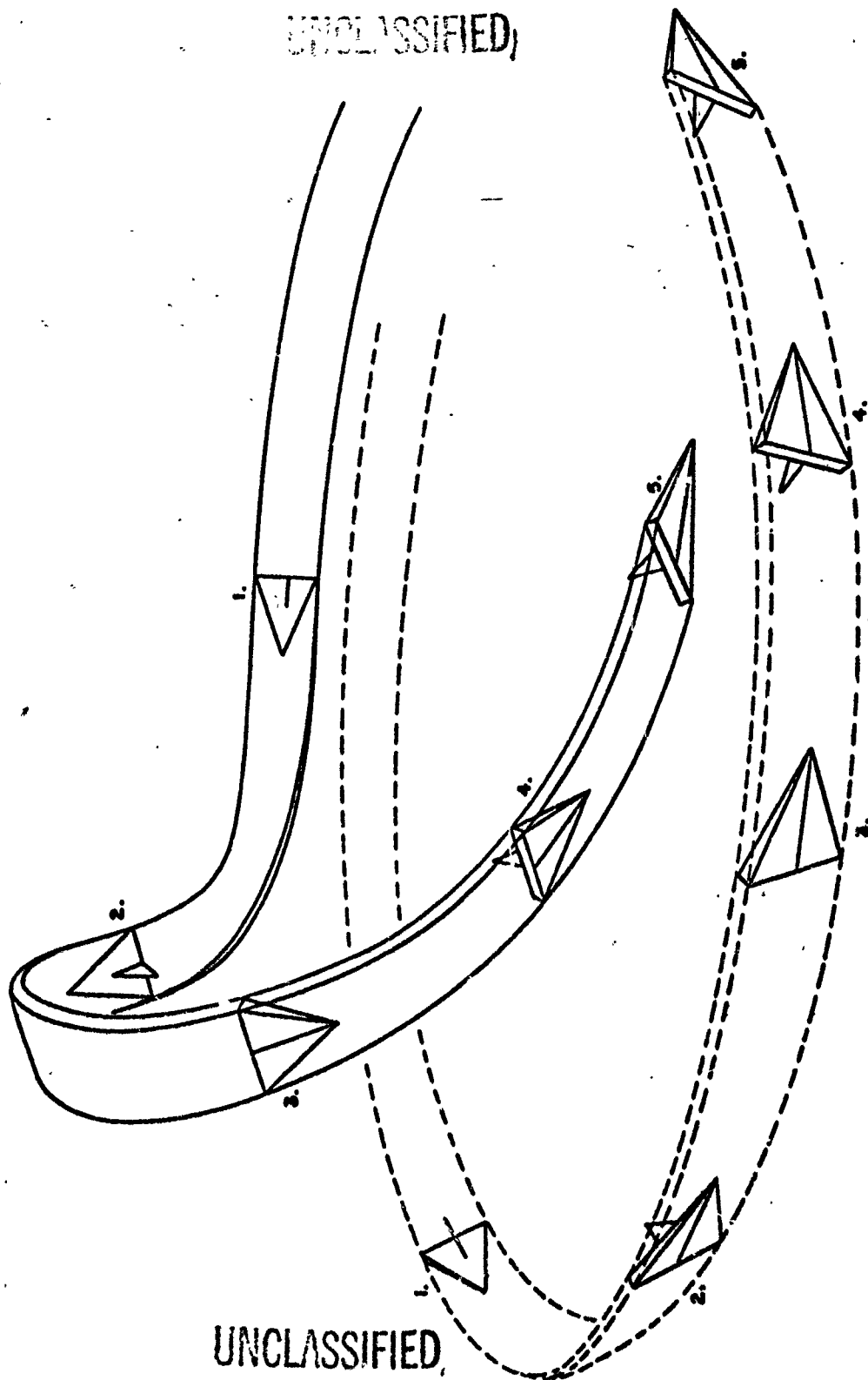
commit themselves to one of the defenders. Once the attacker commitment has been made, the defender under attack maneuvers as required to stay alive, and the free defender effects a "sandwich", with the attacker(s) in the middle. Several options are available depending on the attacker(s) commitment.

9. For full information on Air Combat Tactics Maneuvers, refer to USAF Fighter Weapons School Lesson Plan 50-10-6C "Aerial Attack Study".

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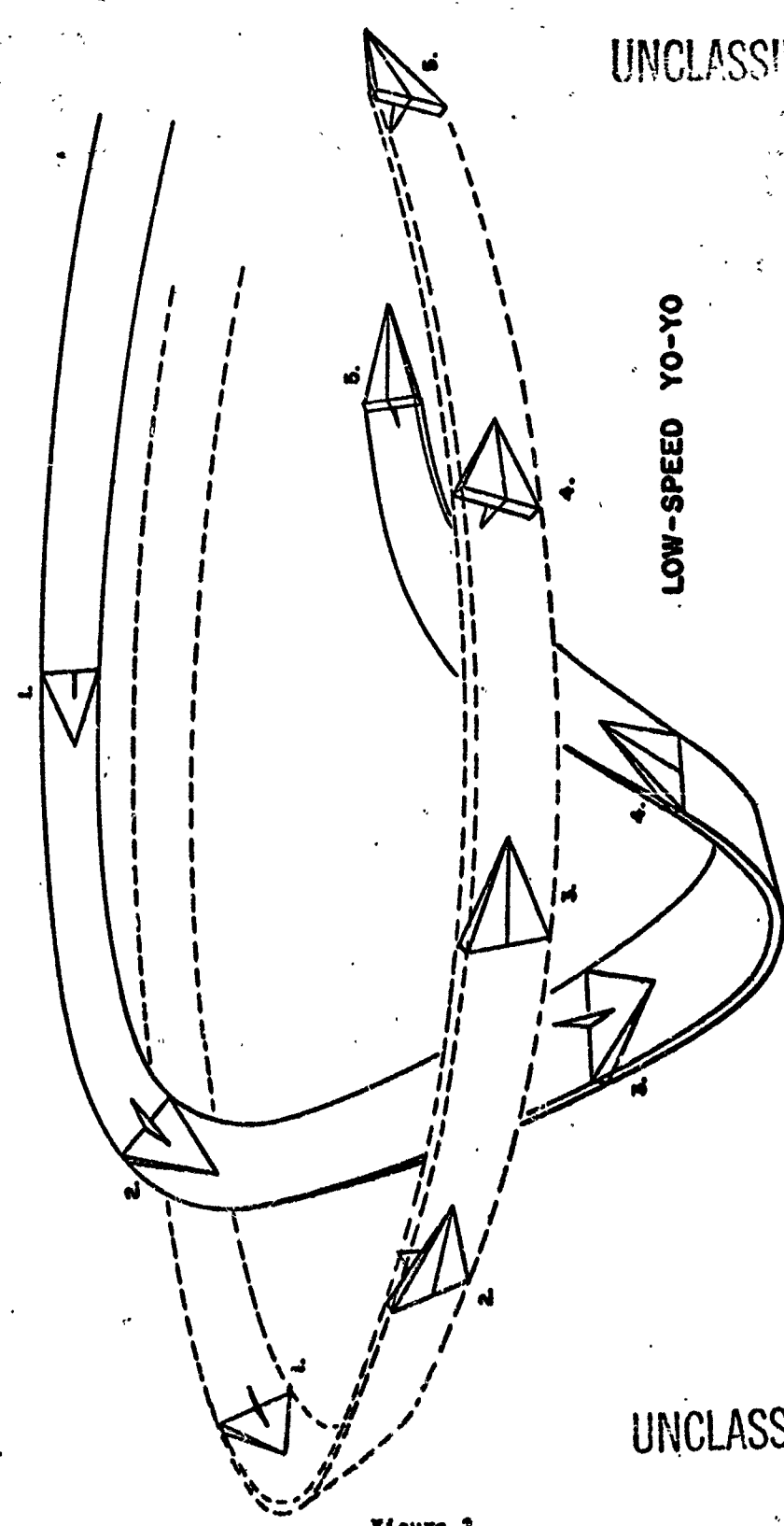
HIGH-SPEED YO-YO

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Figure 1

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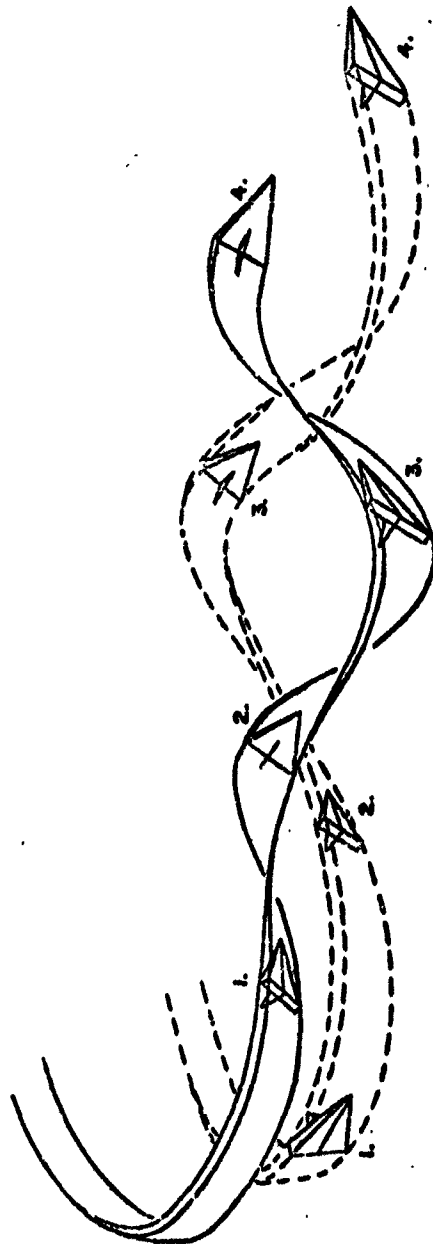
LOW-SPEED YO-YO



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Figure 2

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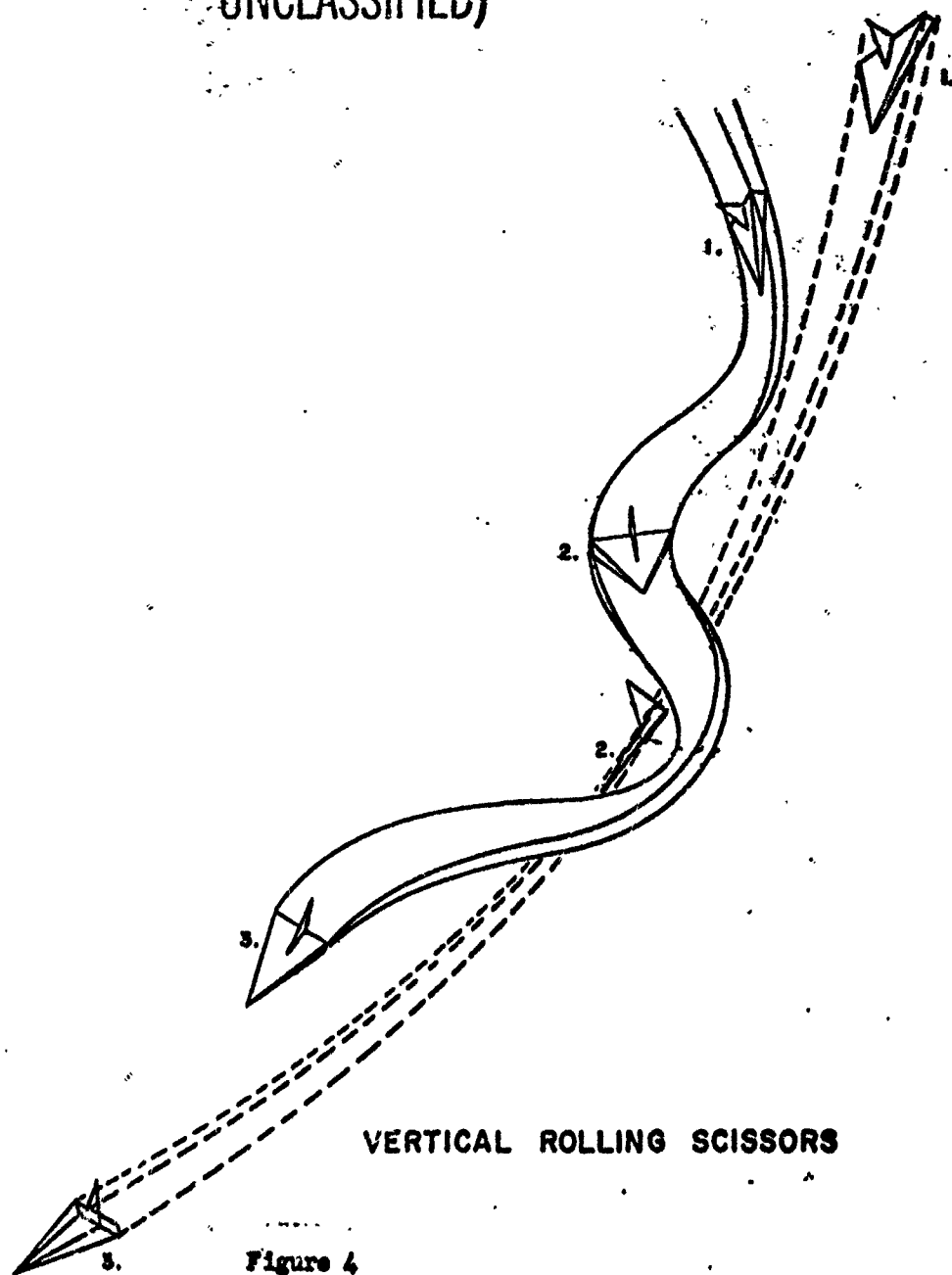
SCISSORS

Figure 3

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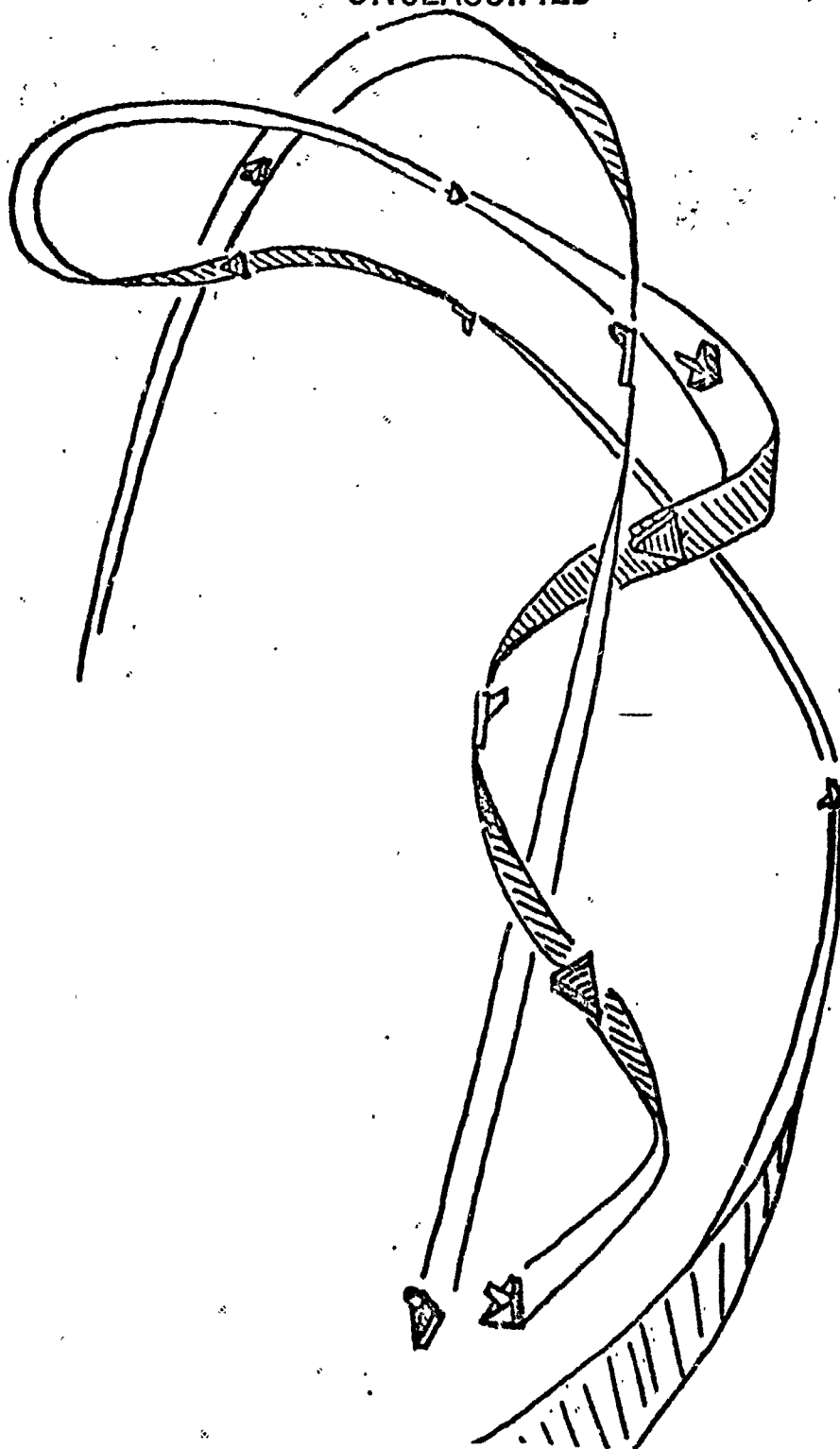
VERTICAL ROLLING SCISSORS

Figure 4

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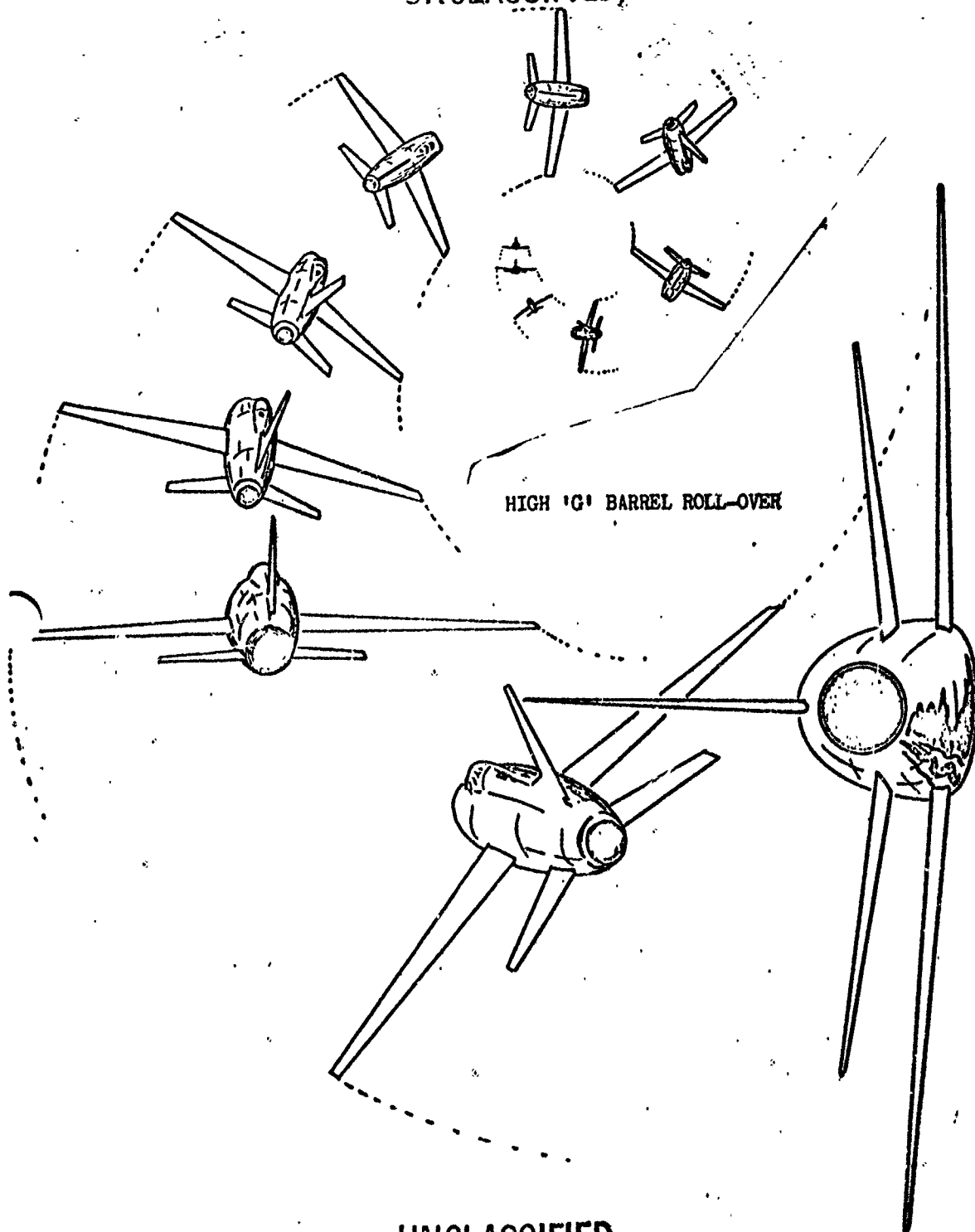


BARREL-ROLL ATTACK

Figure 5

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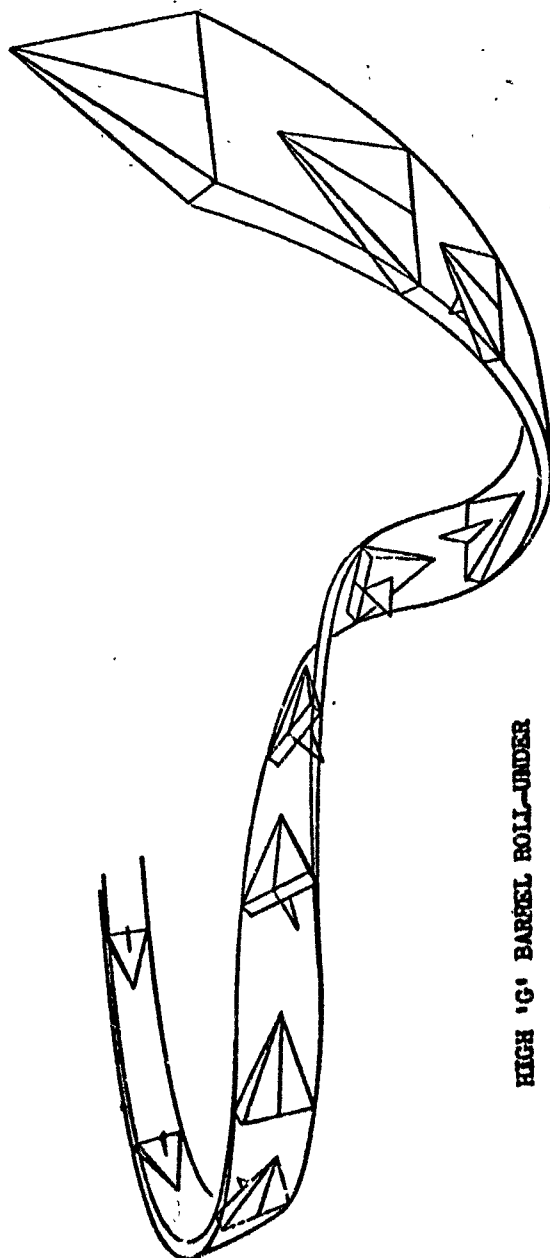
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Figure 6

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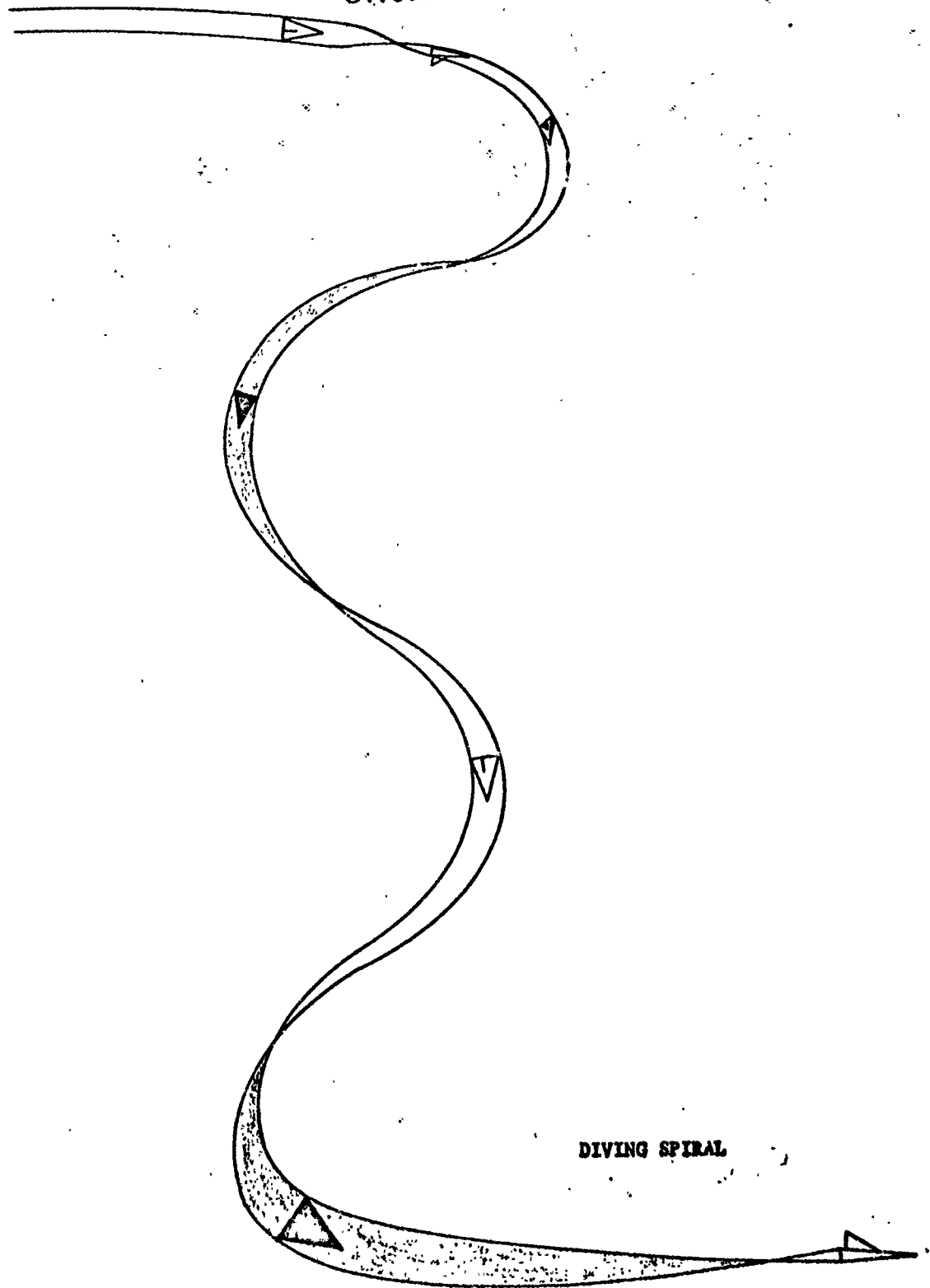


HIGH 'G' BARREL ROLL-UNDER

Figure 7

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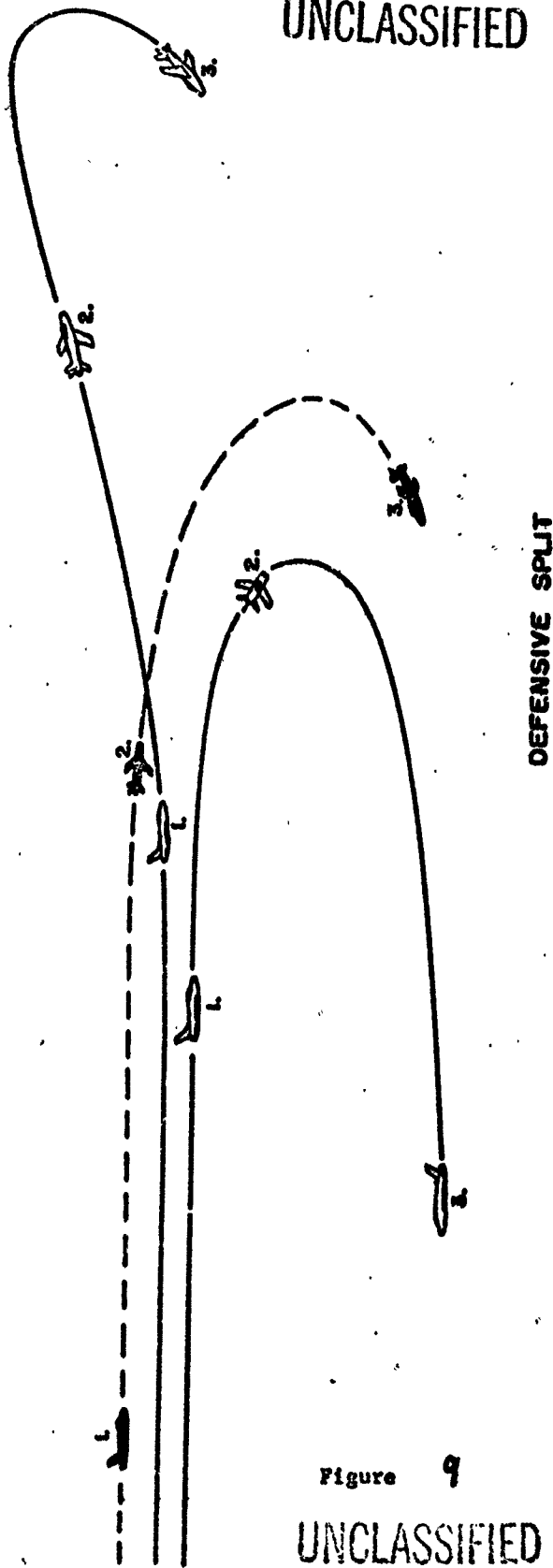


DIVING SPIRAL

Figure 8

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**Figure 9**

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ANNEX G  
ENERGY MANEUVERABILITY

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ENERGY MANEUVERABILITY MAXIMUM SUSTAINED G CAPABILITY

1. During the first week of the evaluation, F-86H, F-100D, and F-105D aircraft performed thrust limited level turns to spot check maximum sustained G values at the zero Ps point (level flight) shown on the PsV energy maneuverability charts contained in this annex. These checks were performed at selected indicated machs, and for the F-86H and F-100 .02 mach was added to the recorded speeds to obtain a true mach reading with which to enter the PsV charts. F-105 aircraft cockpit mach indication is in true mach.
2. To gather such data, pilots climbed to either 15,000' or 35,000', as briefed, acquired the specified indicated mach in level flight and then entered a level turn, advancing power to the specified setting as G was increased. The turn was then held as tight as possible without encountering speed or altitude loss, and average cockpit G meter readings were recorded through a stabilized turn of 90° - 180°.
3. This data is presented in Table 1. The values listed under "Predicted Max G" are from the PsV diagrams in this annex for the specified aircraft, true mach, and altitude. For the F-86H, there are presently no PsV charts. For purposes of comparison, corresponding values for the MIG 17 (AB power) are shown in the "Predicted Max G" column for the F-86H entries. The PsV diagrams were computed for 50% of internal fuel remaining. Such amounts of fuel for each type of aircraft are as follows:  

F-100 - 3900#  
F-105D - 5000#  
F-86H - 1800#

The actual fuel remaining at the time the data was recorded is presented, since some degradation or improvement in performance would be reflected



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with variation in fuel remaining.

4. It must be emphasized that the recorded data is presented only as a guide, in that inaccuracies could be attributed to any or all of the following factors. Data was observed visually by the pilot and recorded on a knee board.

- a. Pilot technique.
- b. Cockpit instrument inaccuracy.
- c. Variations in thrust.
- d. Variation in fuel on board.
- e. Non-standard atmosphere conditions.

5. It should be noted that the values computed for the MIG 17 in AB power exceed in all cases the values recorded for the F-86H.

6. At the present time a full test on verification of EM data is being conducted at Eglin AFB, utilizing instrumented aircraft and more exact testing techniques.

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TABLE 1

<u>Type Aircraft</u>	<u>Altitude</u>	<u>True Mach</u>	<u>Power Setting</u>	<u>Recorded Max G</u>	<u>Predicted Max G</u>	<u>Fuel Remaining/#</u>
F-100D	35,000'	.92	MIL	1.2		5200
F-100D	35,000'	.92	MIL	1.2	2.0	5200
F-100D	35,000'	.82	MIL	1.5		5100
F-100D	35,000'	.82	MIL	1.5	1.9	4800
F-100D	35,000'	.92	MAX	2.3		5000
F-100D	35,000'	.92	MAX	3.0	2.6	4800
F-100D	35,000'	1.12	MAX	2.0		3800
F-100D	35,000'	1.12	MAX	2.5	1.3	4900
F-100D	15,000'	.82	MIL	3.0	3.5	3000
F-100D	15,000'	.92	MIL	1.0		4500
F-100D	15,000'	.92	MIL	1.0	2.2	4500
F-100D	15,000'	.82	MAX	4.5	5.0+	2800
F-100D	15,000'	.92	MAX	3.5		3300
F-100D	15,000'	.92	MAX	3.5	5.0+	4400
F-105D	35,000'	.8	MIL	1.3	1.2	2300
F-105D	35,000'	.9	MIL	1.4	1.3	7100
F-105D	35,000'	.8	MAX	1.75	1.5	7200
F-105D	35,000'	.9	MAX	2.0	1.9	7000
F-105D	35,000'	1.1	MAX	2.0	2.0	6900
F-105D	35,000'	1.3	MAX	2.1	2.0	5500
F-105D	15,000'	.7	MIL	2.5	2.3	3500

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<u>Type Aircraft</u>	<u>Altitude</u>	<u>True Mach</u>	<u>Power Setting</u>	<u>Recorded Max G</u>	<u>Predicated Max G</u>	<u>Fuel Re- maining/#</u>
F-105D	15,000'	.8	MIL	2.7	2.6	3300
F-105D	15,000'	.9	MIL	3.2	3.0	3200
F-86H*	35,000'	.72	MIL	2.0		2200
F-86H	35,000'	.72	MIL	2.5		2600
F-86H	35,000'	.72	MIL	2.2	(2.8)	2000
F-86H	35,000'	.82	MIL	2.2		2100
F-86H	35,000'	.82	MIL	2.6		2600
F-86H	35,000'	.82	MIL	2.0		1800
F-86H	35,000'	.82	MIL	1.9	(3.0)	3200
F-86H	35,000'	.92	MIL	1.6		2200
F-86H	35,000'	.92	MIL	1.1		1600
F-86H	35,000'	.92	MIL	1.6		3300
F-86H	35,000'	.92	MIL	1.75	(2.8)	2200
F-86H	15,000'	.72	MIL	5.0 +		1500
F-86H	15,000'	.72	MIL	4.5 - 5.0		1600
F-86H	15,000'	.72	MIL	5.5		2400
F-86H	15,000'	.72	MIL	5.0	(5.0+)	-
F-86H	15,000'	.82	MIL	4.5		1700
F-86H	15,000'	.82	MIL	4.5		2300
F-86H	15,000'	.82	MIL	4.7		1700
F-86H	15,000'	.82	MIL	4.0	(5.0+)	-
F-86H	15,000'	.92	MIL	2.5		1700

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<u>Type Aircraft</u>	<u>Altitude</u>	<u>True Mach</u>	<u>Power Setting</u>	<u>Recorded Max G</u>	<u>Predicted Max G</u>	<u>Fuel Remaining/#</u>
F-86H	15,000'	.92	MIL	1.3		1500
F-86H	15,000'	.92	MIL	1.8		-
F-86H	15,000'	.92	MIL	2.75		2200
F-86H	15,000'	.92	MIL	3.0	(4.3)	1600

\*Note variation between individual F-86H readings, particularly at .92 mach and 15,000'.

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**ENERGY MANEUVERABILITY THEORY**

1. **DEFINITION OF TERMS:** Energy Maneuverability Theory is a system of quantitatively relating the performance of different aircraft at any airspeed or altitude. For use of this theory in tactics evaluation and performance comparison, two basic concepts are involved.

a. **Specific Energy Level:** This is a measure of the energy possessed by a fighter as a result of its position at a particular speed and altitude. A fighter with a high Specific Energy Level has an advantage in speed and/or altitude over one with low Specific Energy Level. Hard maneuvering especially at high altitudes, normally causes a Specific Energy Loss, hence it is to the advantage of an attacking aircraft to initiate the attack with a higher energy level than its opponent. The attacker can afford then to trade this energy while maneuvering for position.

b. **Specific Excess Power or Energy Rate:** Energy rate is a measure of the time rate at which a fighter gains or loses energy and is equivalent to the specific excess power of that fighter. Specific excess power is that amount of extra power possessed by the fighter after the normal power required merely to "stay in the air" has been subtracted. In other words, it is a measure of the extra power available to climb, accelerate, or turn tighter as required by the maneuvering situation. A positive energy rate, thus indicates capability for gain of speed, altitude, or G, while a negative rate indicates that the fighter must lose speed and/or altitude or it must relax the G load.

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$$E_s = \text{Specific Energy} = h + \frac{v^2}{64.4}$$

$E_s$  Units in feet

$h$  = height in feet

$V$  = velocity in feet per second (true airspeed)

$P_s$  = Specific excess power = energy rate

$P_s$  Units in feet/sec

2. PsV DIAGRAM: Refer to figure 10 and note the following.

- a. At .8M, pulling 5 Gs, the F-104 and MIG 21 are an even match.

Both have a positive  $P_s$  of approximately 325 ft/sec. The specific excess power (energy rate) can be used to increase altitude, airspeed, or turn (G).

- b. At 1.1M, pulling 5 Gs, the F-104 has a negative  $P_s$  of 220 and the MIG 21 has a negative  $P_s$  of 150. Both aircraft are losing energy, but the F-104 is losing it faster.

- c. The F-104 has an advantage (sea level) from .7 or .8M to slightly over mach one.

3. HV (Energy Rate) DIAGRAM: Refer to figure 11 and note:

- a. At 45M, 1.35M, the F-104 and MIG 21 are an even match. Both aircraft have a positive  $P_s$  of 100 ft/sec. This  $P_s$  can be used to increase altitude, airspeed, or turn (G).

- b. At 48M, the max steady state mach number for the F-104 is 2.0. At the same altitude the MIG 21s max velocity is 2.2M.

- c. At 1.3 or 1.4 to mach 2.0 the F-104 enjoys an advantage at all altitudes, since the solid (F-104) lines fall above the dotted (MIG 21) lines.

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For more detailed information on Energy Maneuverability Theory,  
refer to:

APGD-TDR-64-35 & 38, May 64.

Fighter Weapons School Lesson Plan - "Energy Maneuverability"  
50-10-6e.

4. Energy Maneuverability diagrams are included in this annex to allow  
comparison of energy rate capabilities of the participating TAC Fighters  
and the MIG 15 & 17.

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F-104C —  
MIG-21C - - -

MAXIMUM POWER SEA LEVEL

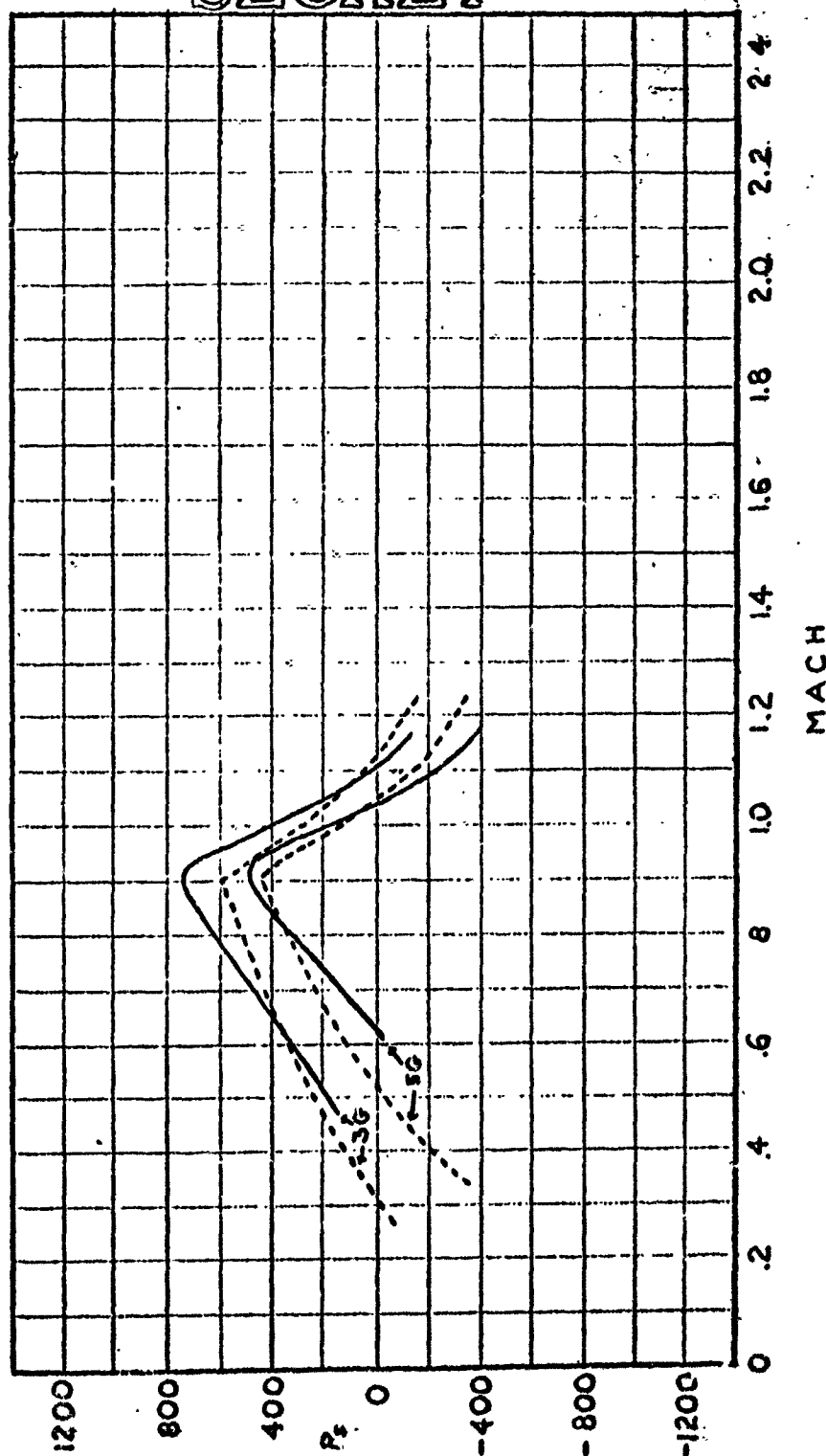


Figure 10

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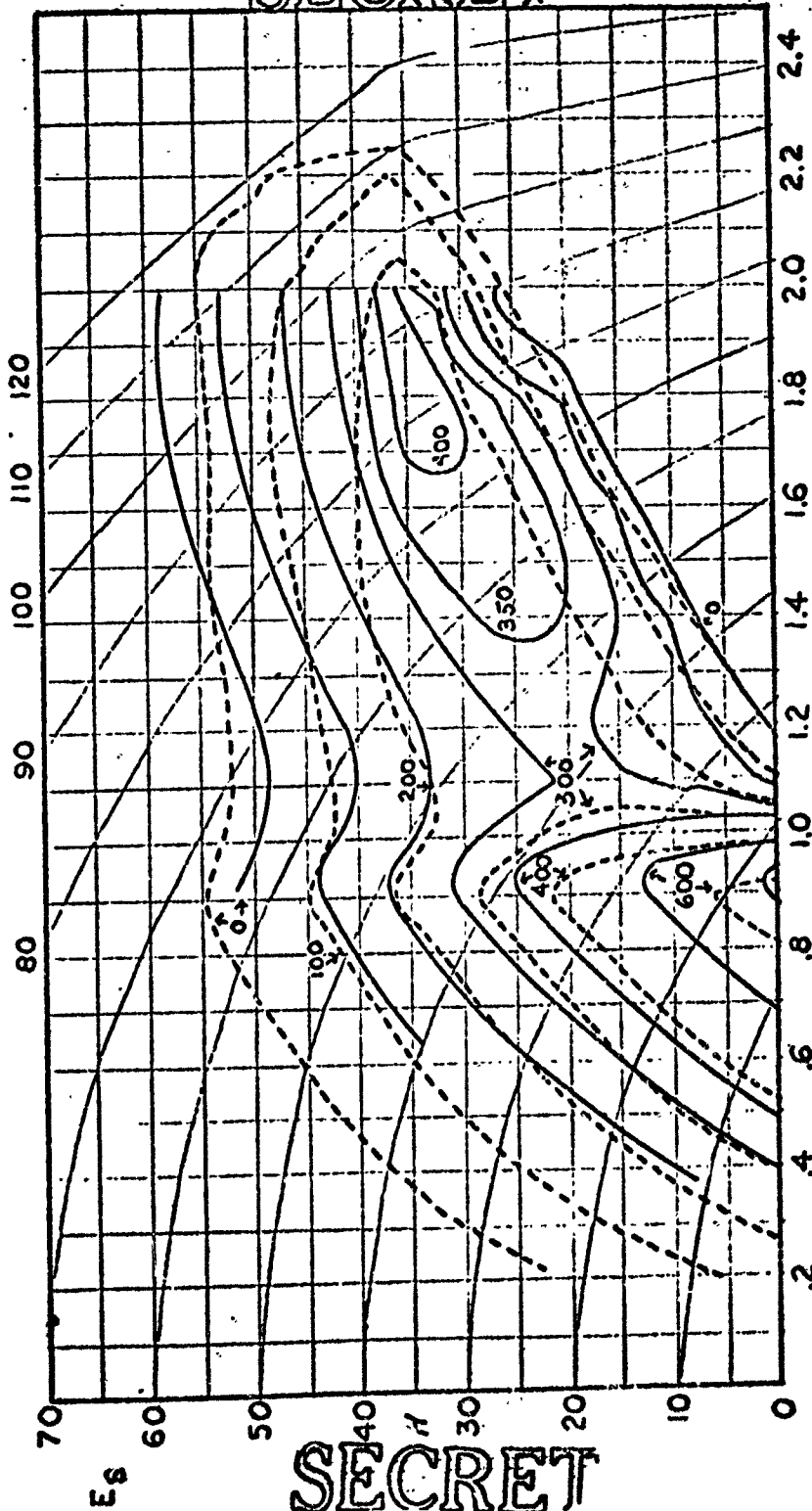
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F-104-C —  
MIG-21C - - -

IG

MAXIMUM POWER

H-V DIAGRAM



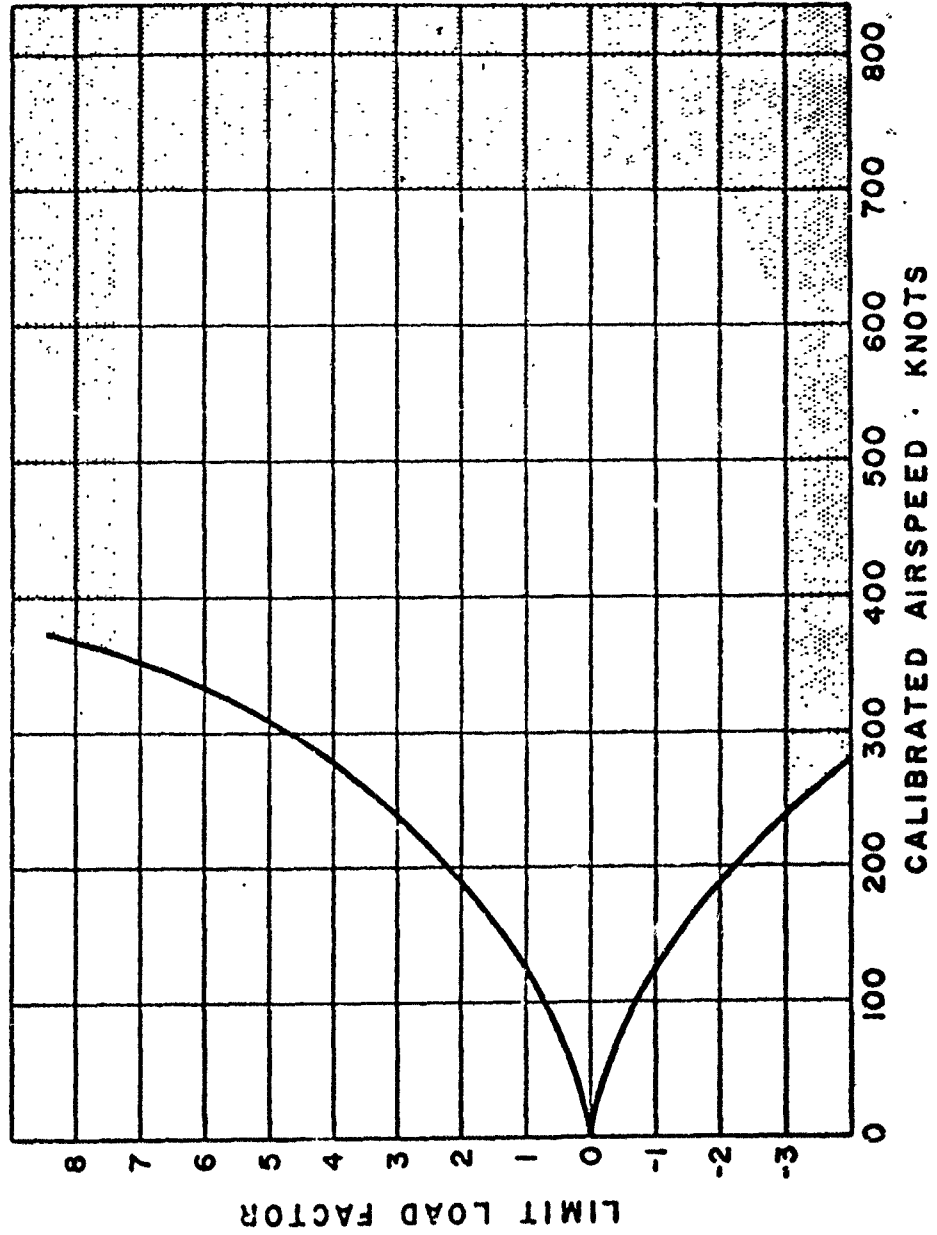
MACH

Figure 11

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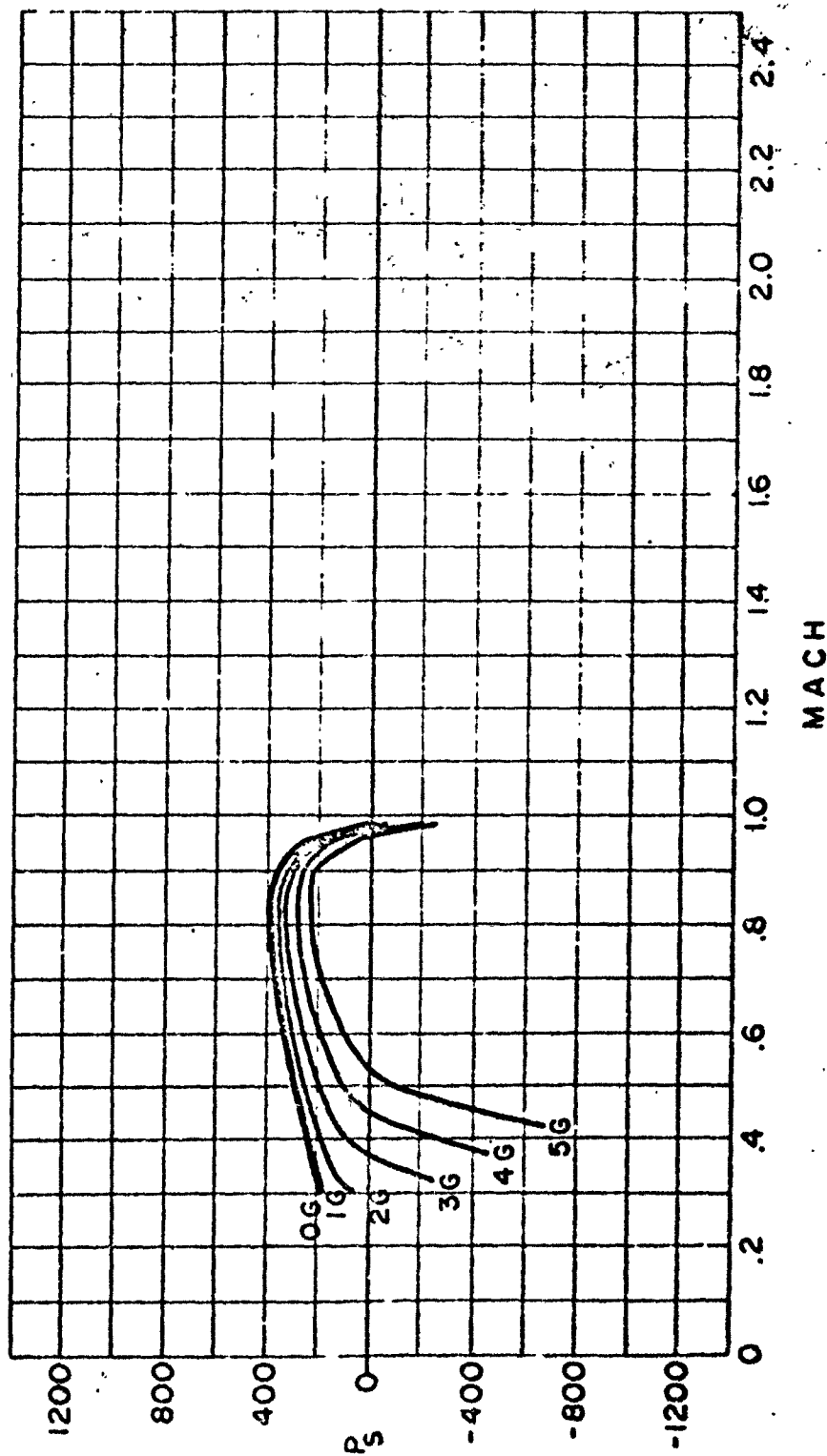
FLIGHT OPERATING LIMITS • F-100D • 30,000'



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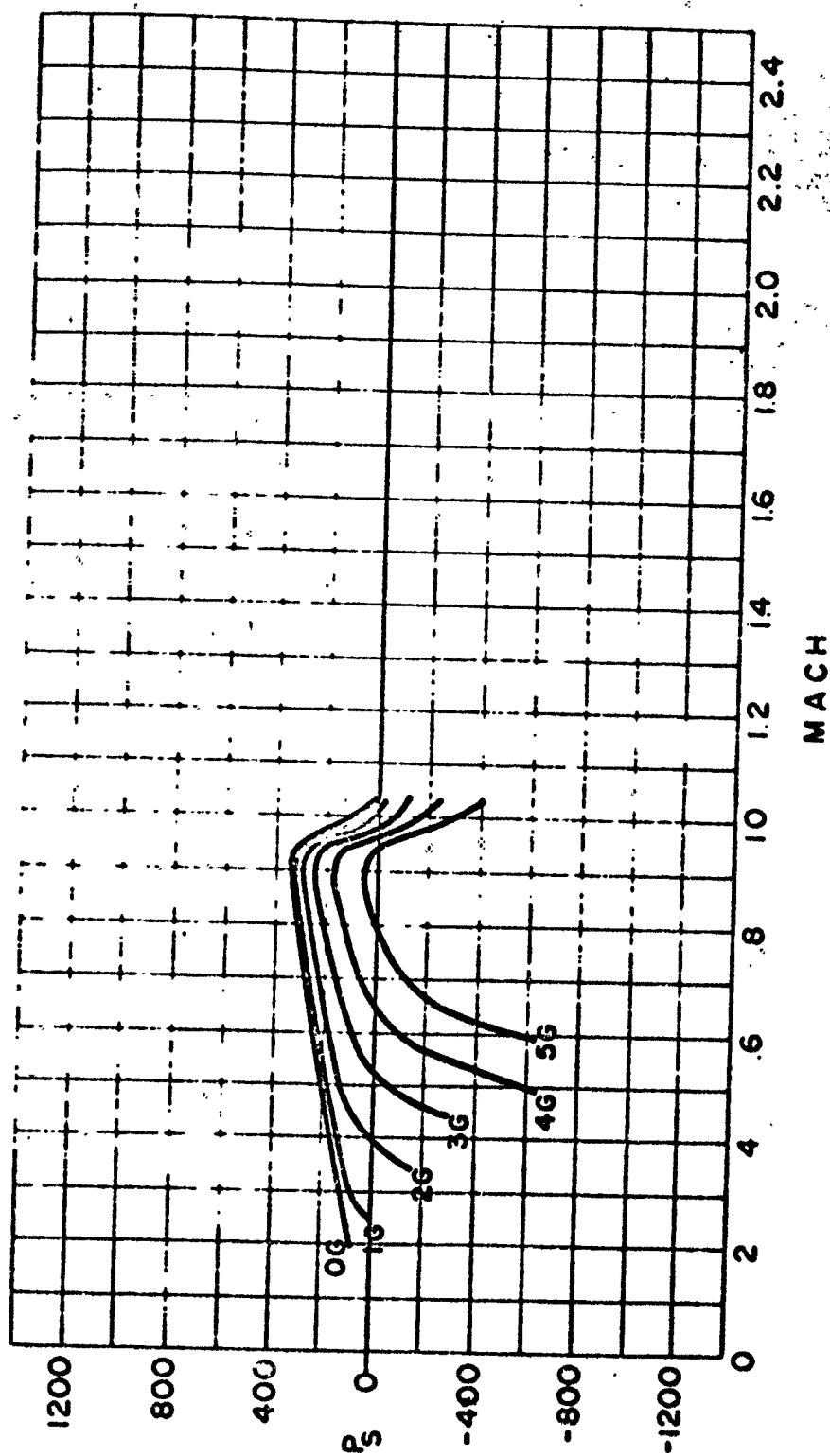
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MAXIMUM POWER · 15,000'

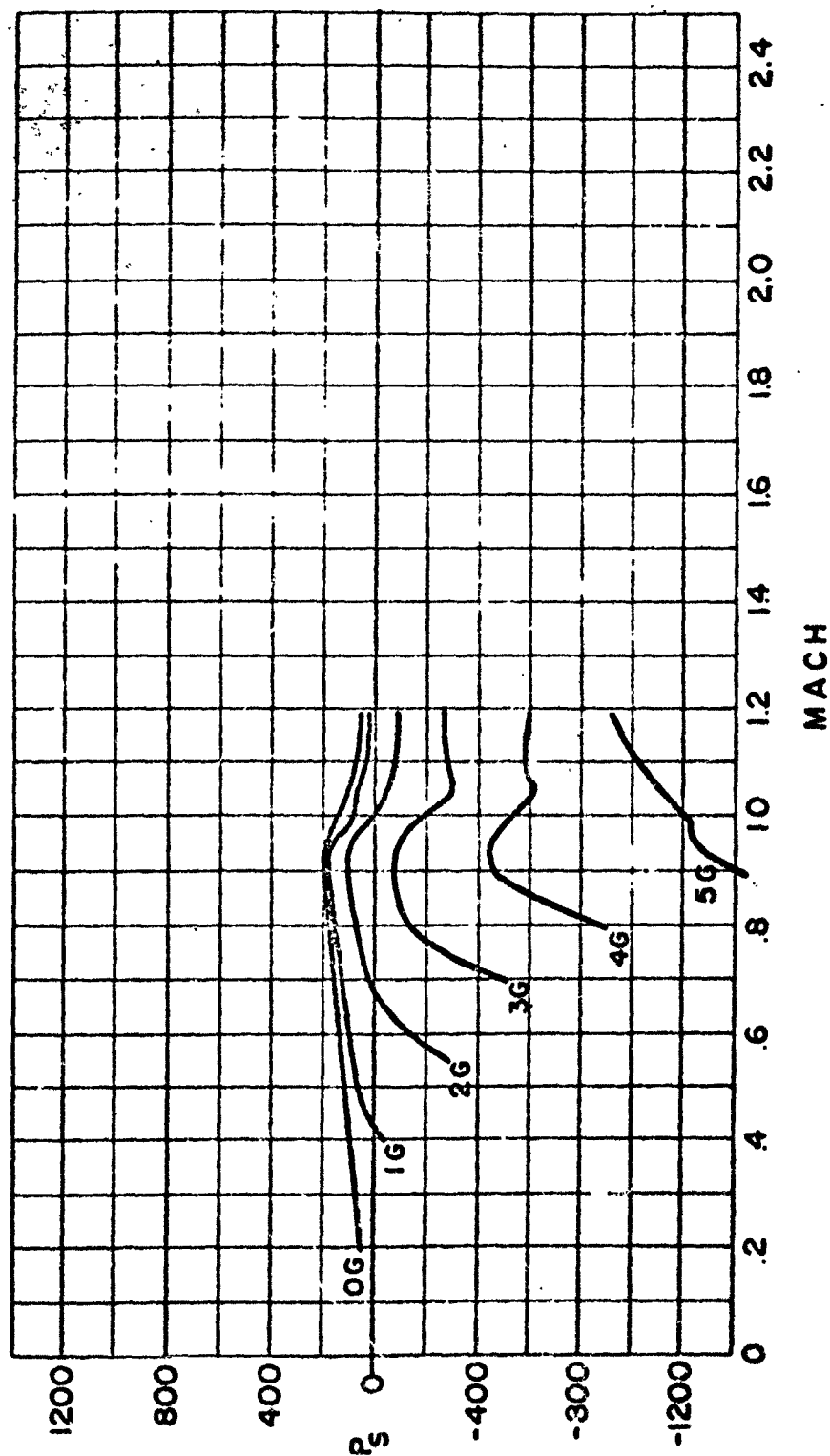
-- F-100D



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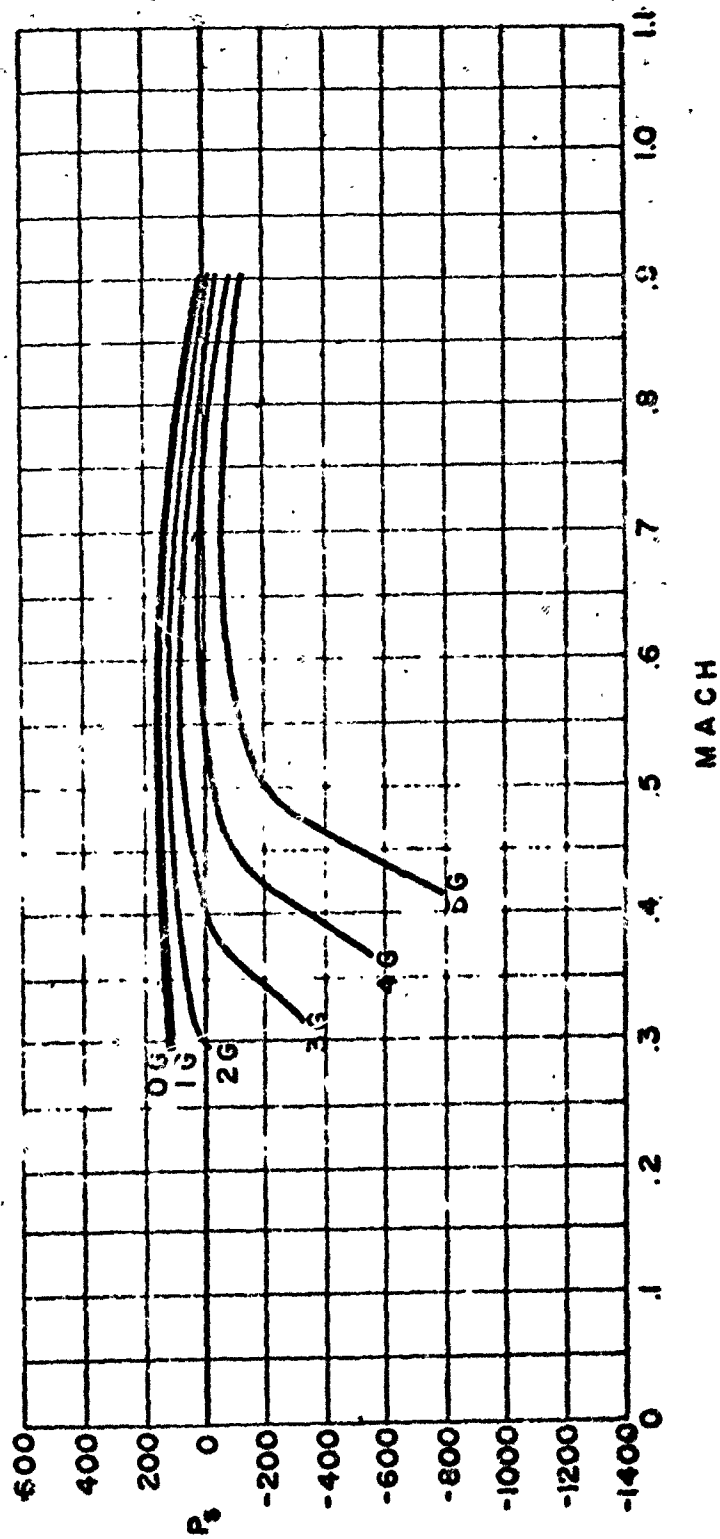
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6 MAXIMUM POWER · 35,000' — F-100D



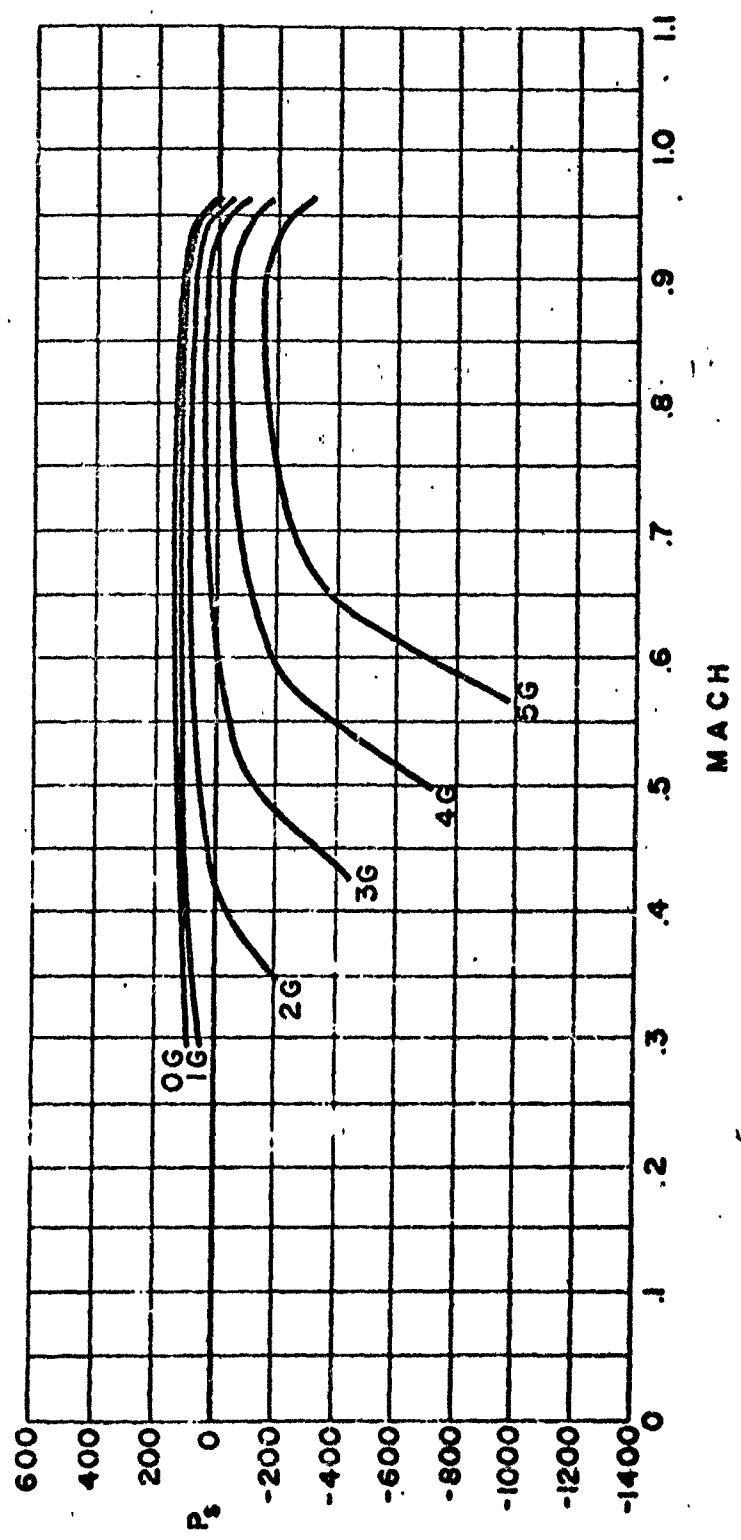
# MILITARY POWER · SEA LEVEL

F-100D



MILITARY POWER · 15,000'

F-100D

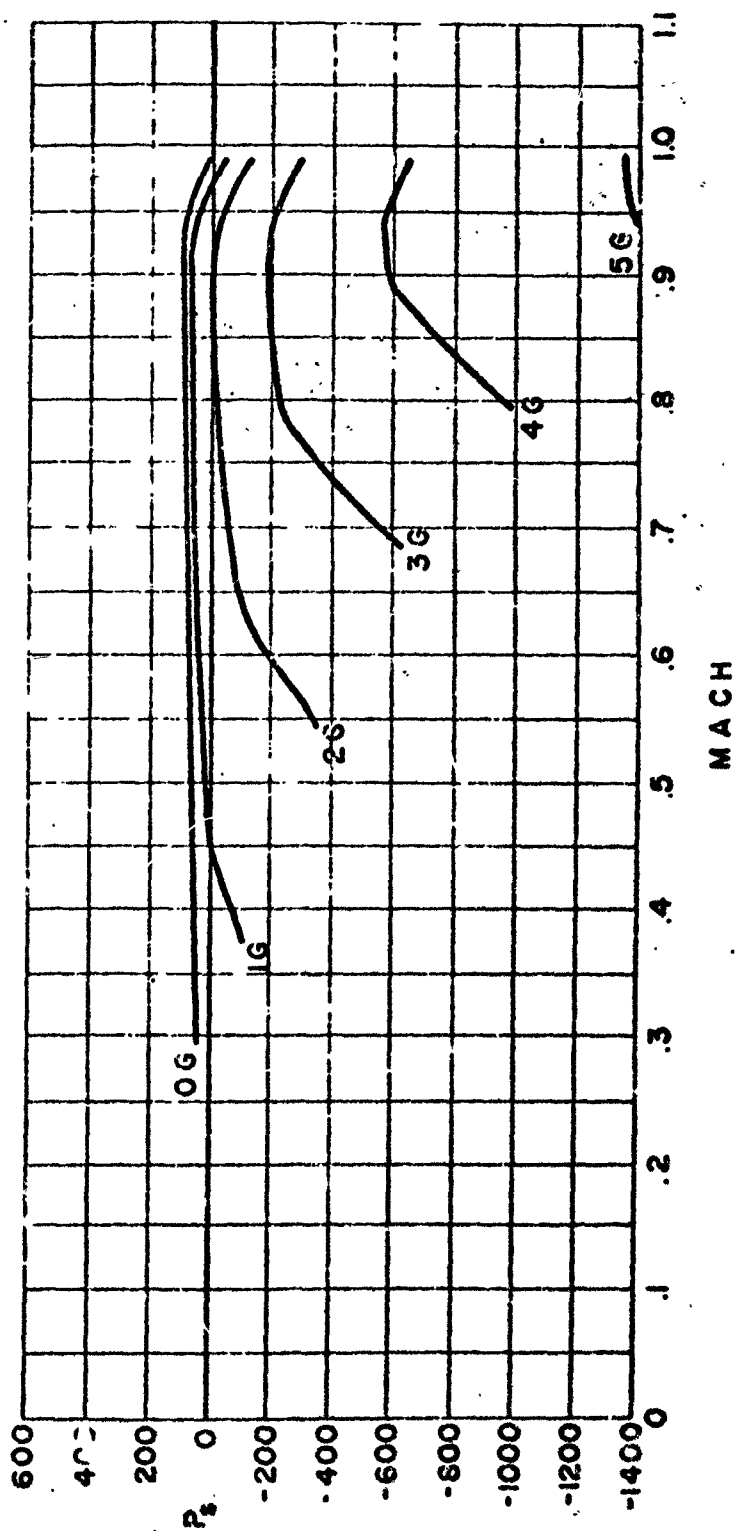


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# MILITARY POWER · 35,000'

F-100D

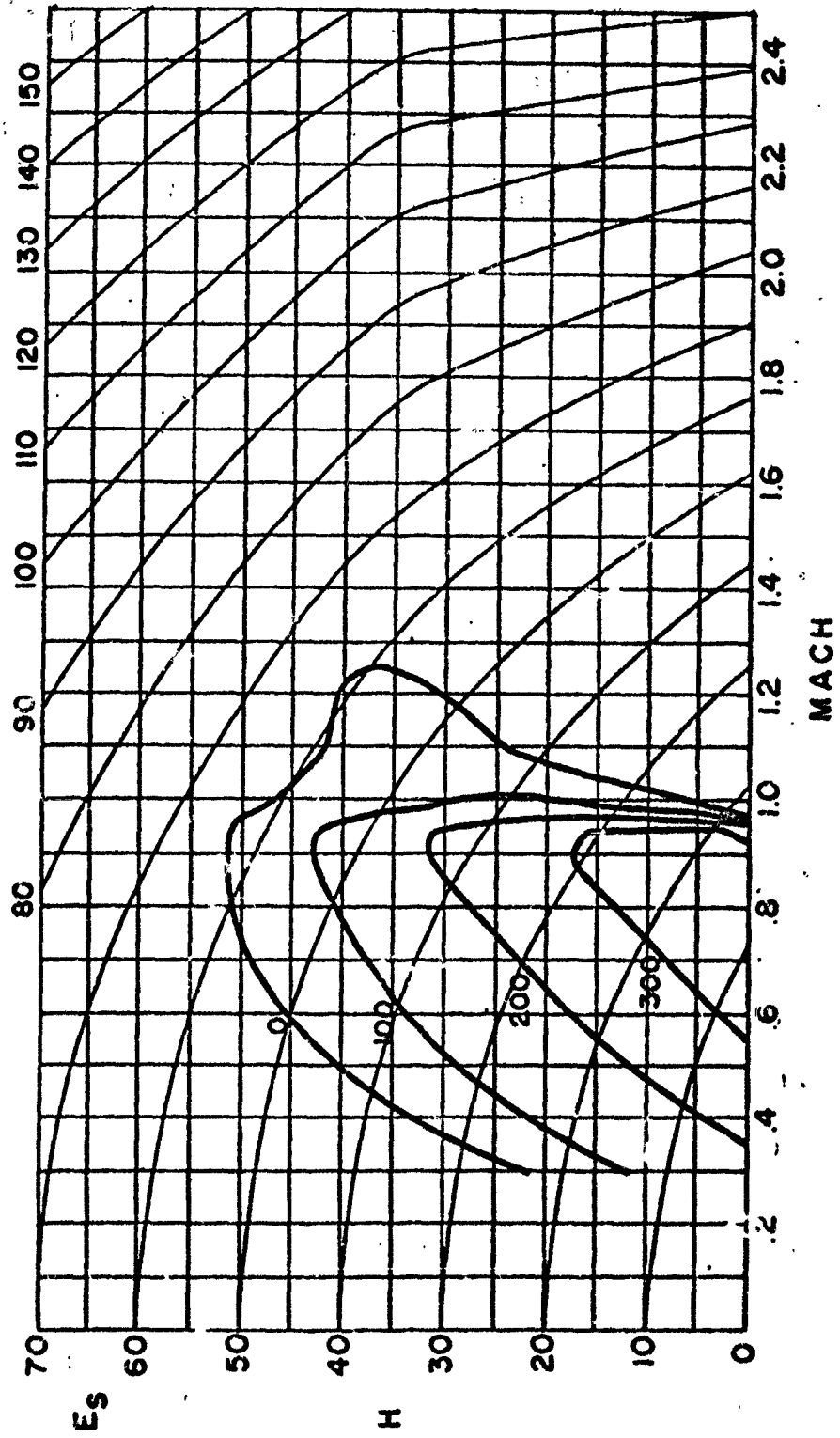




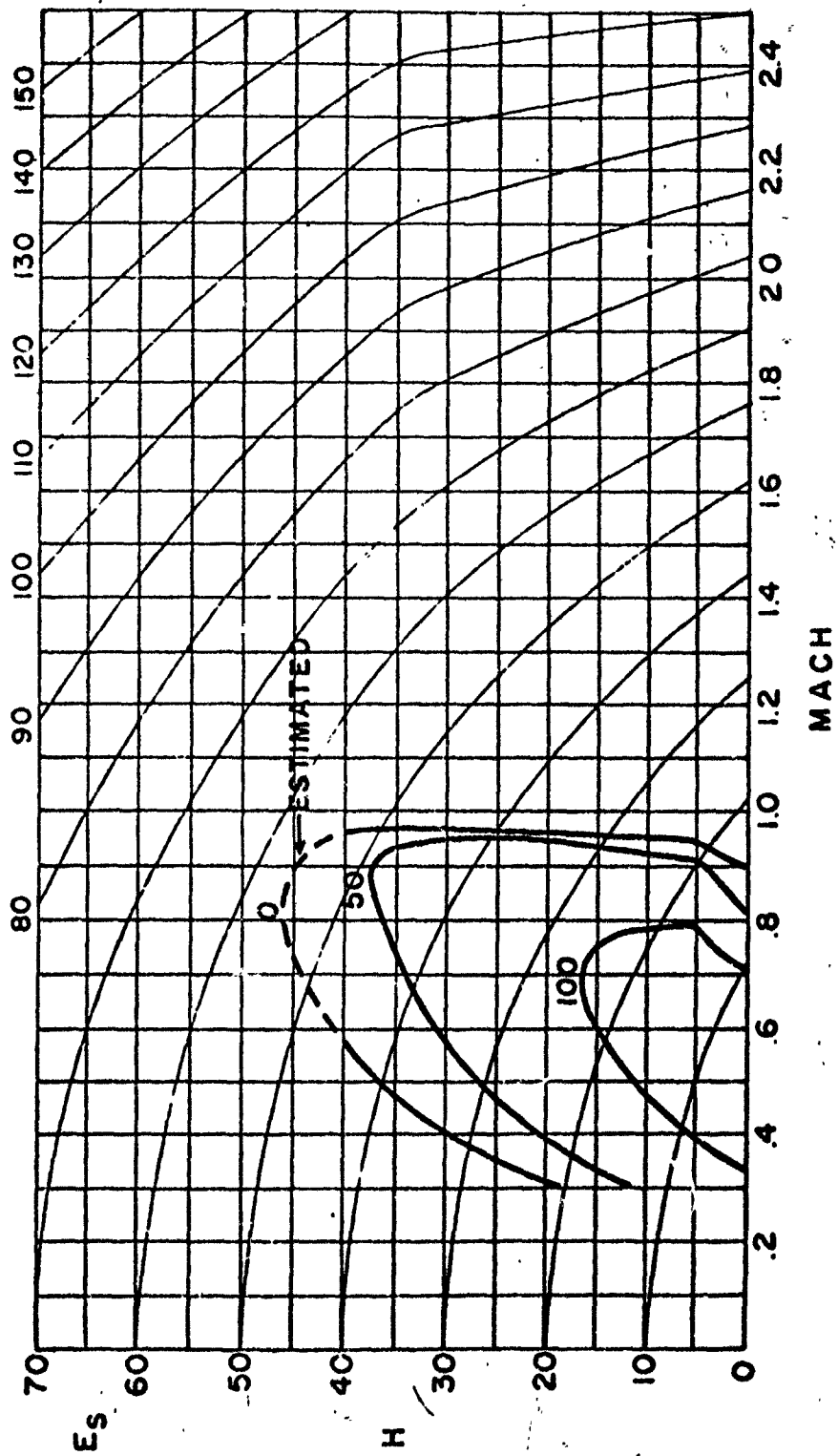
F-100D

MAXIMUM POWER · IG

62



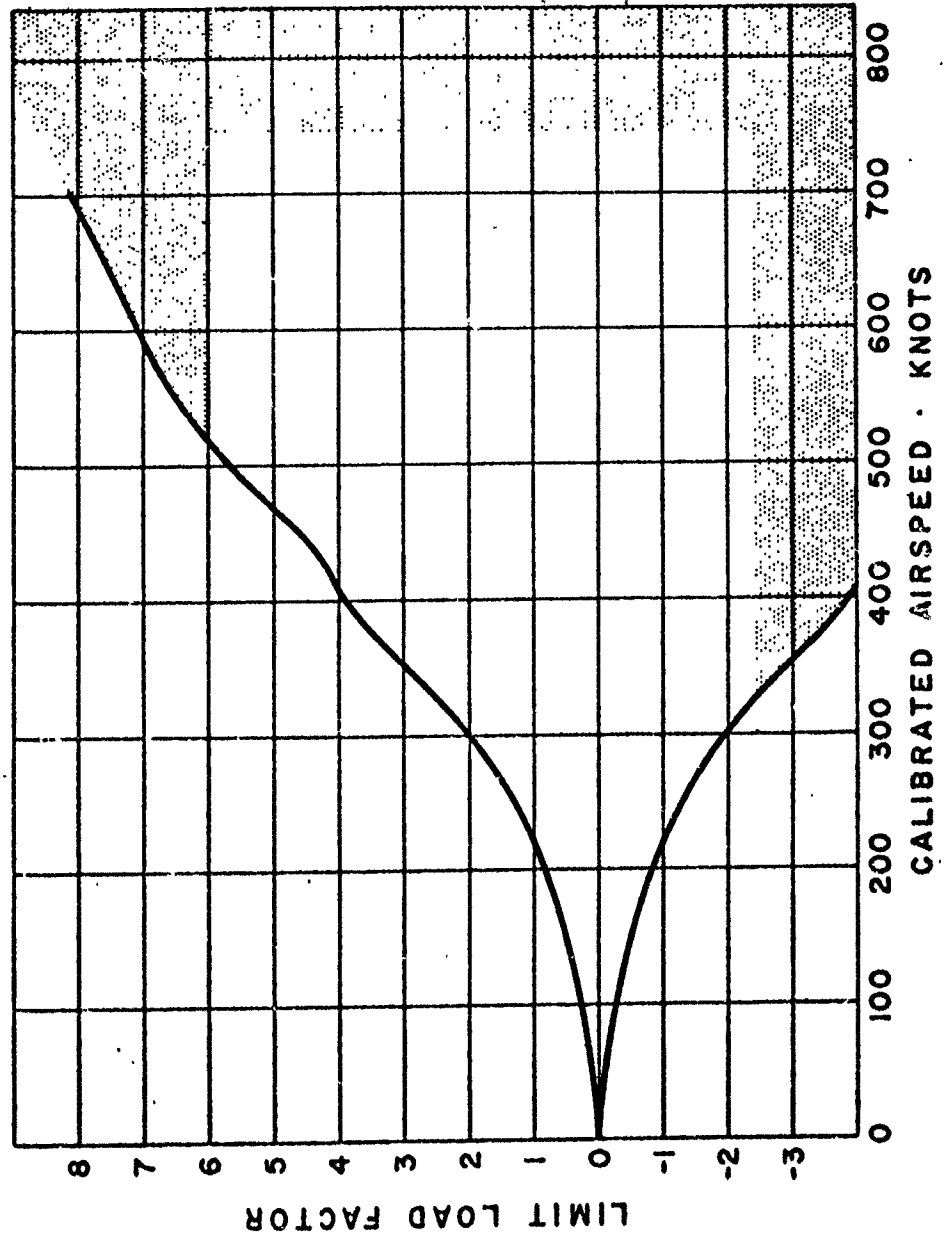
# MILITARY POWER · IG F-100D



CONFIDENTIAL

CONFIDENTIAL

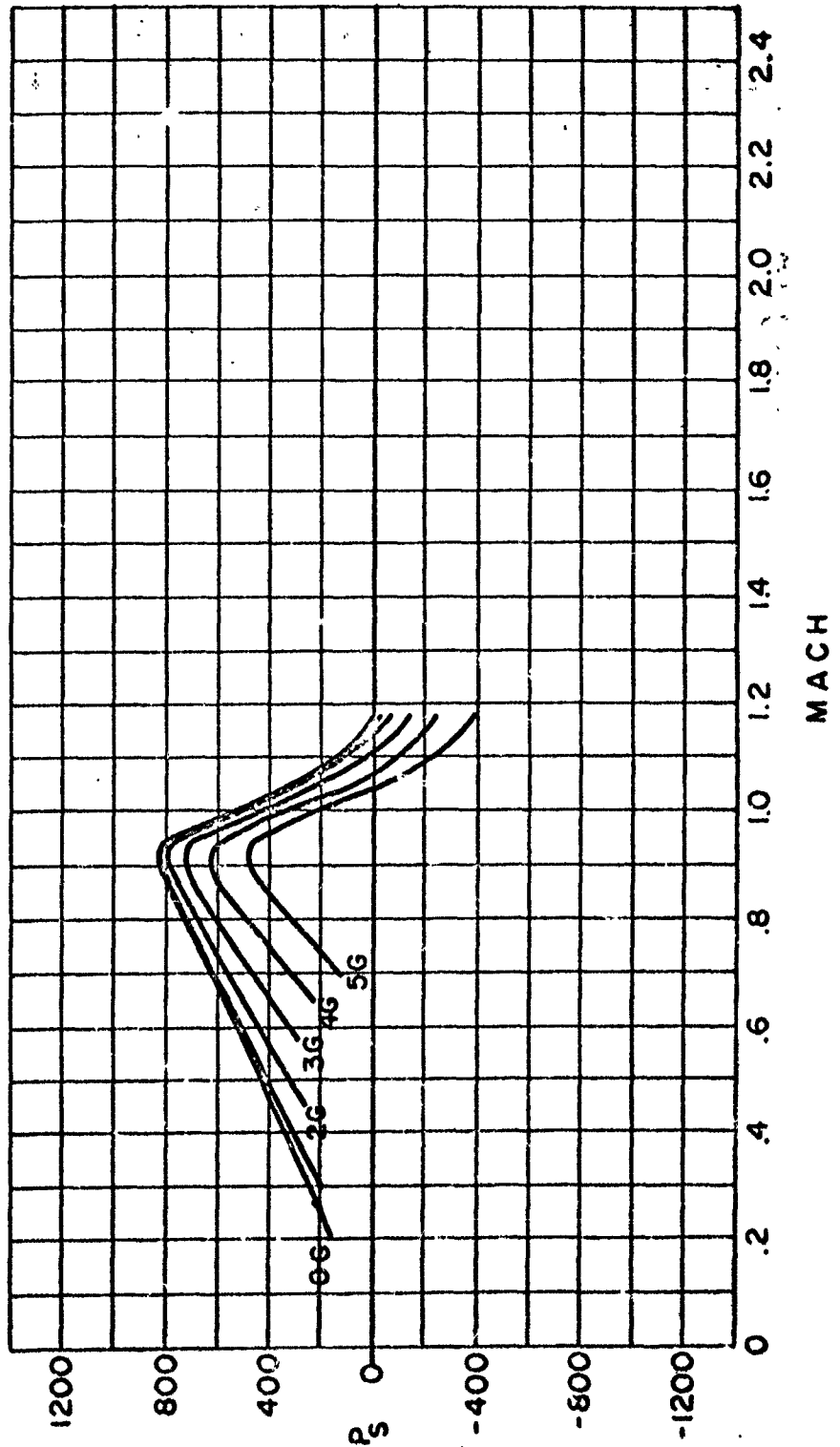
FLIGHT OPERATING LIMITS • F-104C • 30,000'



CONFIDENTIAL

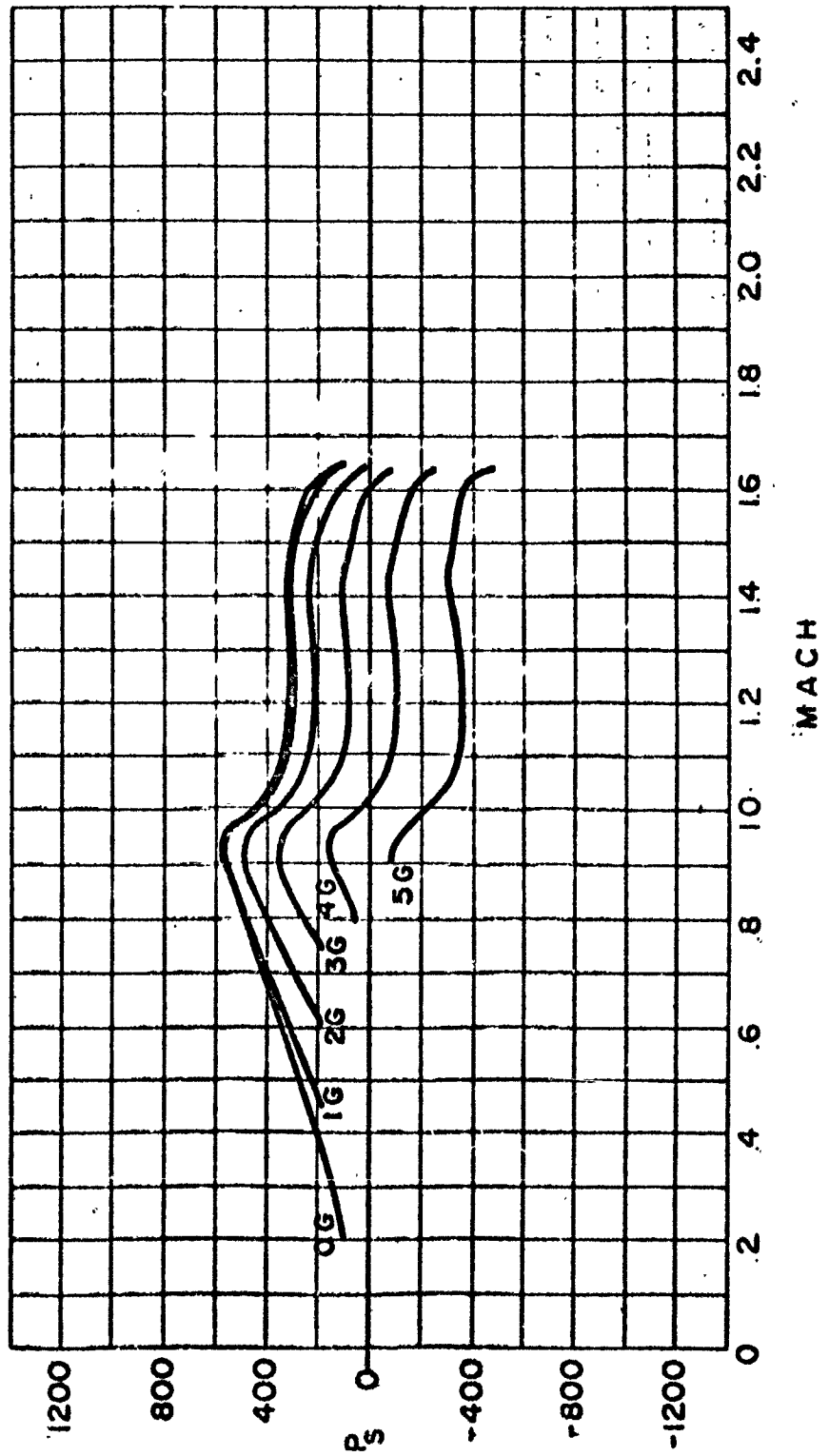
MAXIMUM POWER · SEA LEVEL

F-104C



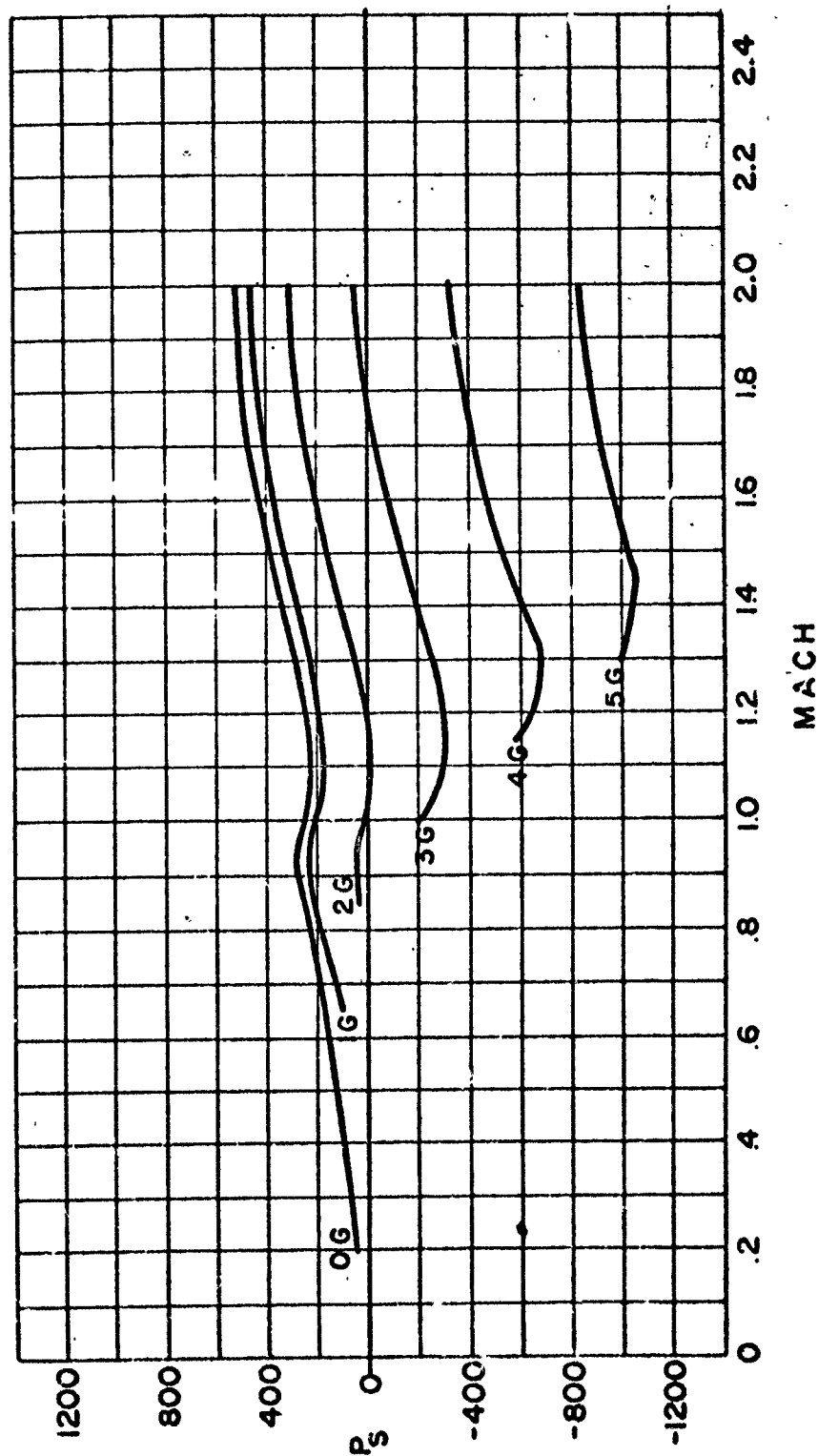
MAXIMUM POWER - 15,000'

F-104C



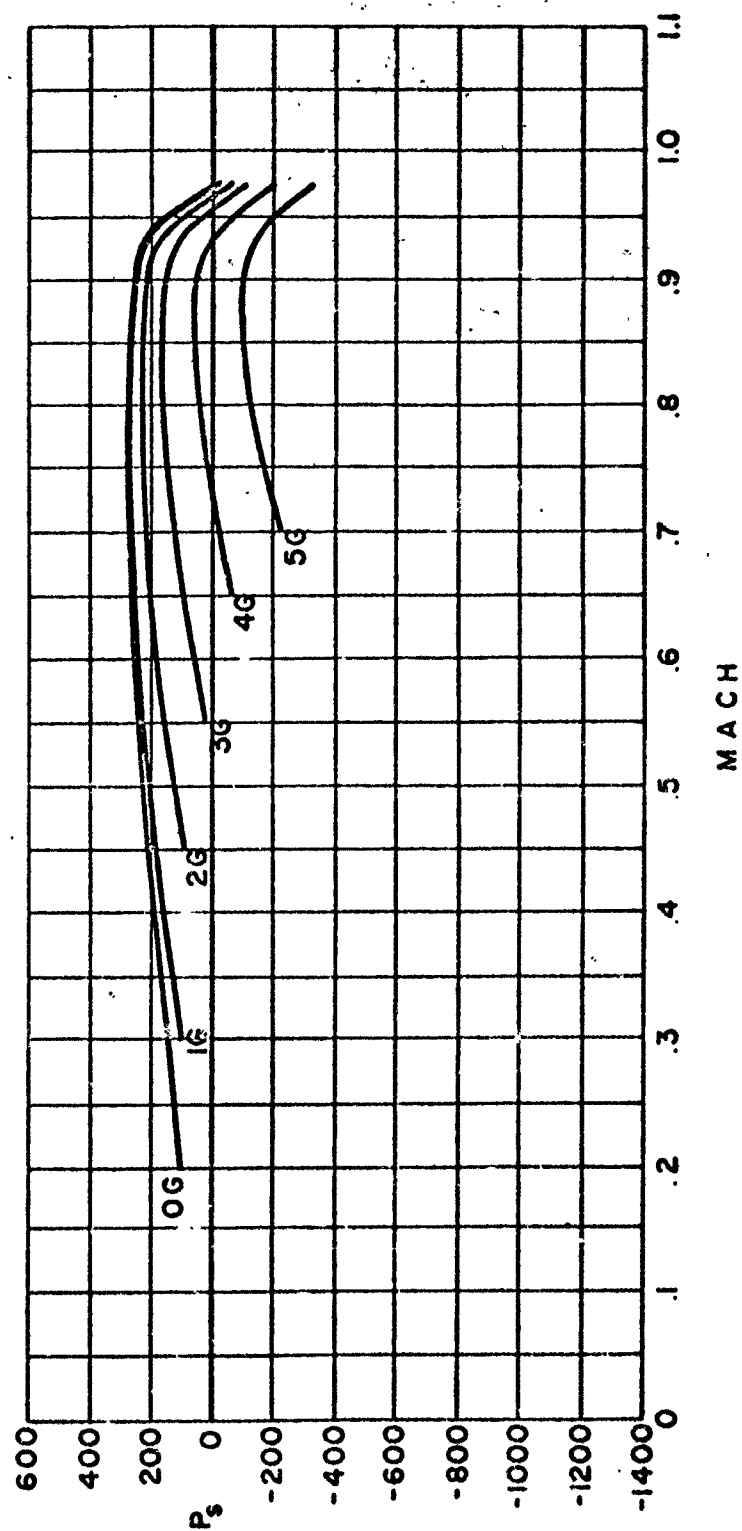
MAXIMUM POWER · 35,000'

F-104C



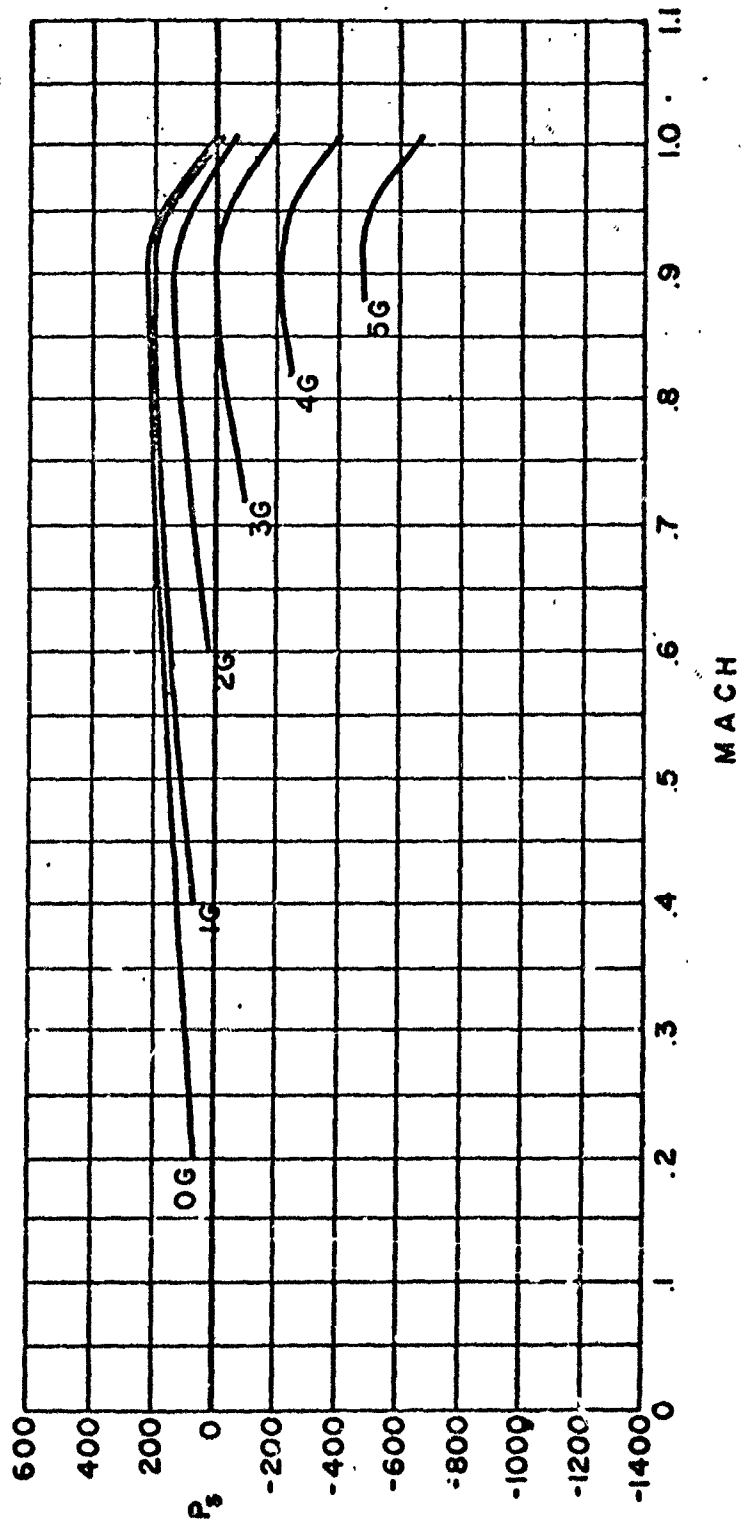
# MILITARY POWER · SEA LEVEL

F-104C



# MILITARY POWER · 15,000'

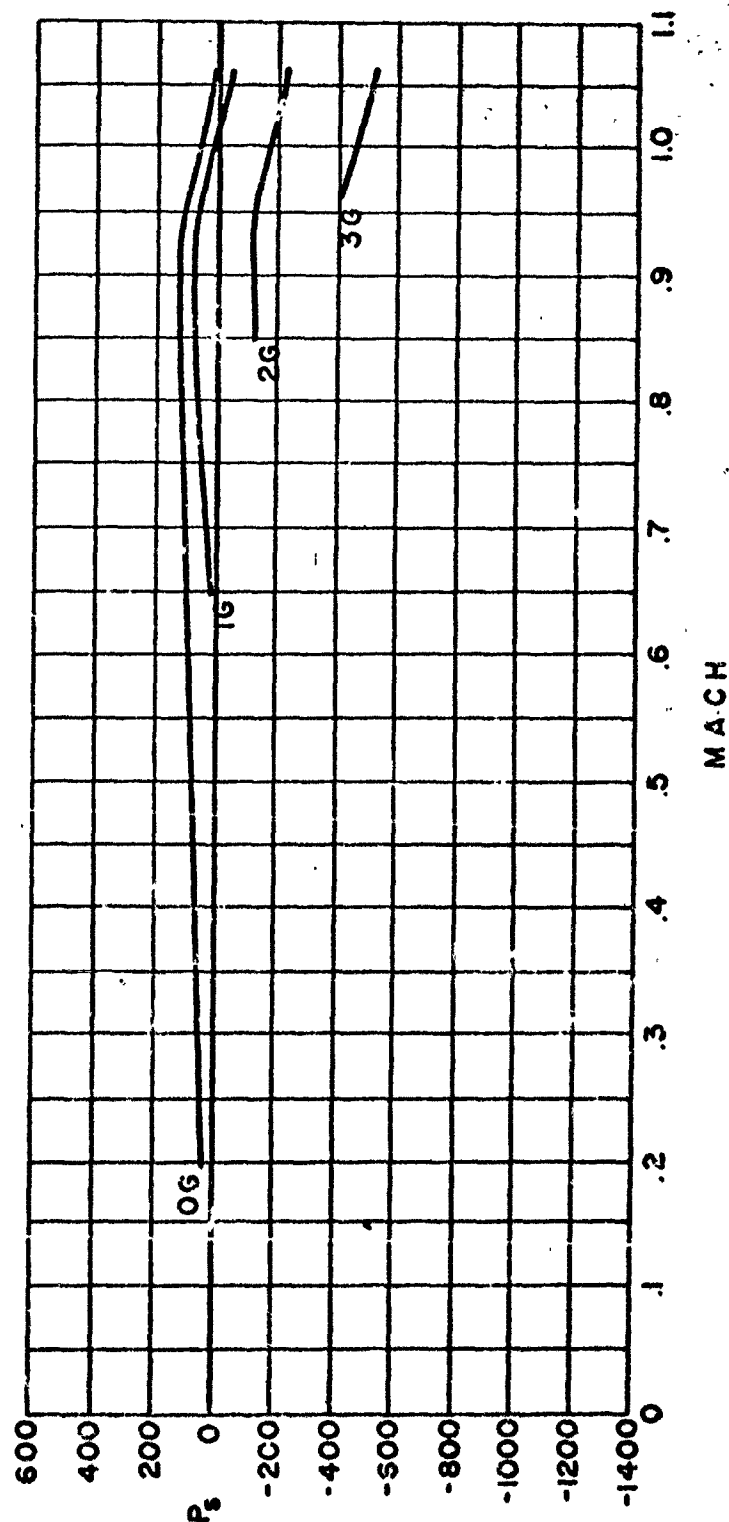
F-104C





# MILITARY POWER · 35,000'

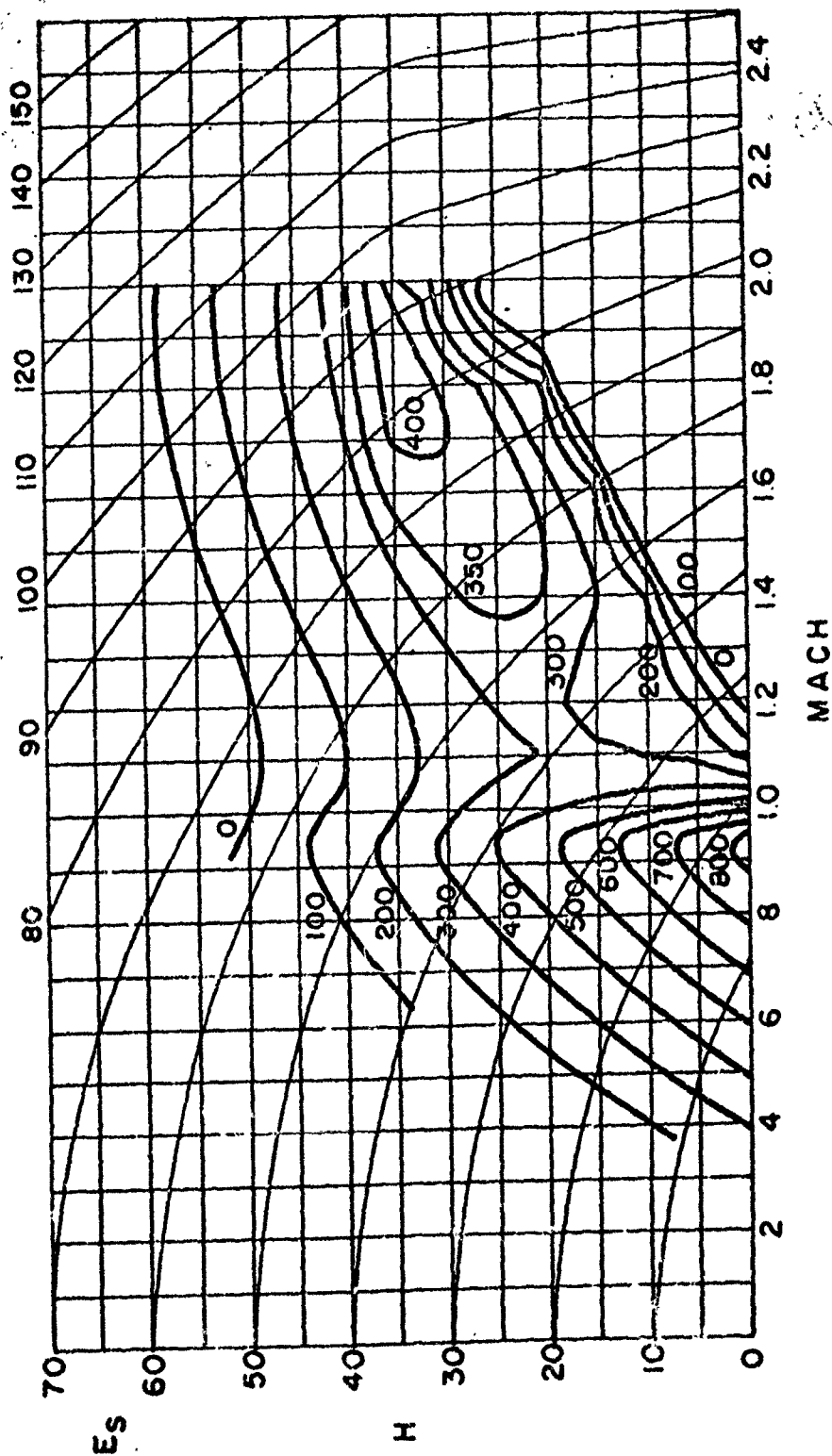
F-104C



F-104C

MAXIMUM POWER · 1G

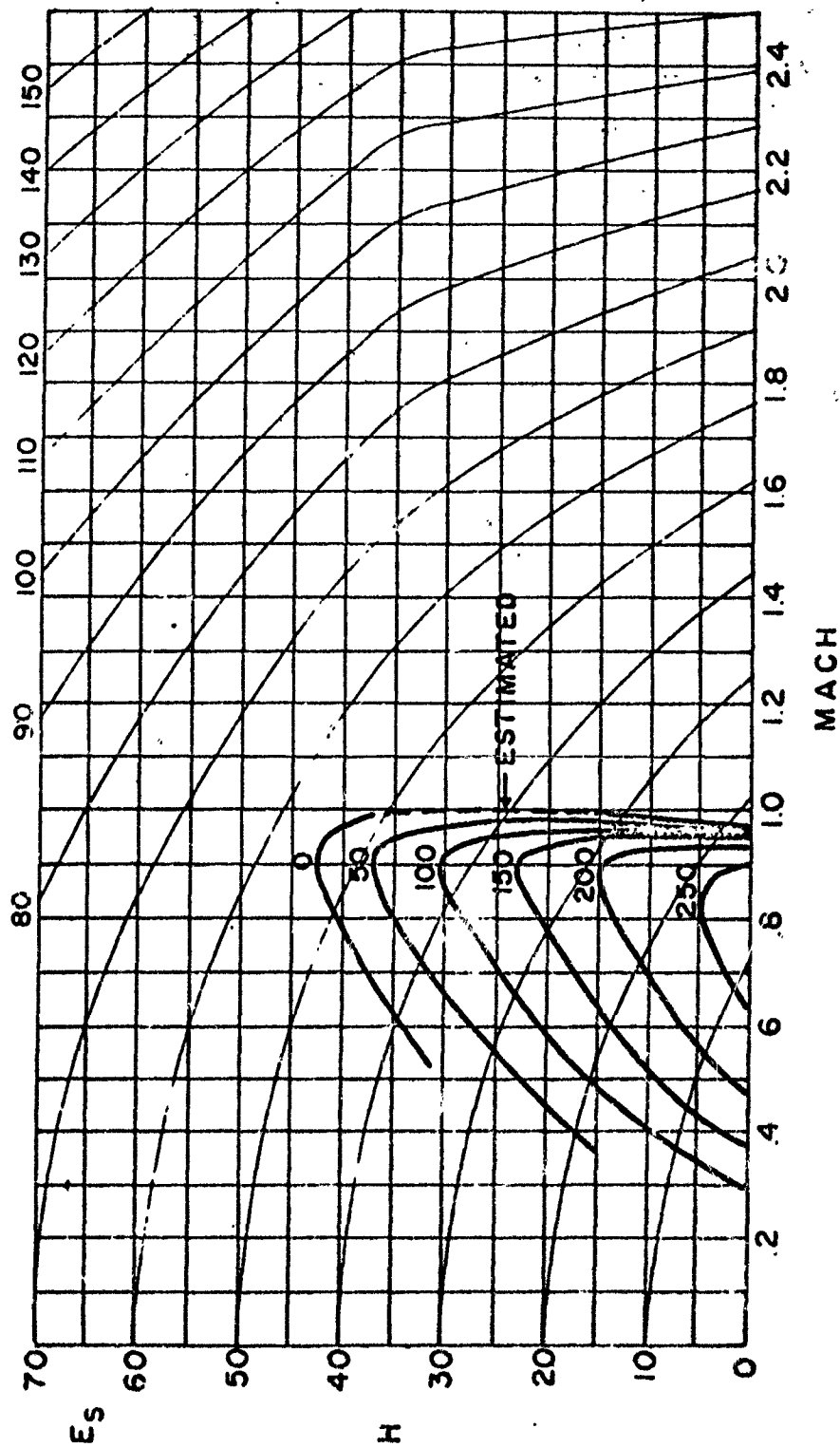
94



CONFIDENTIAL

**% MILITARY POWER · IG**

**F-104C**

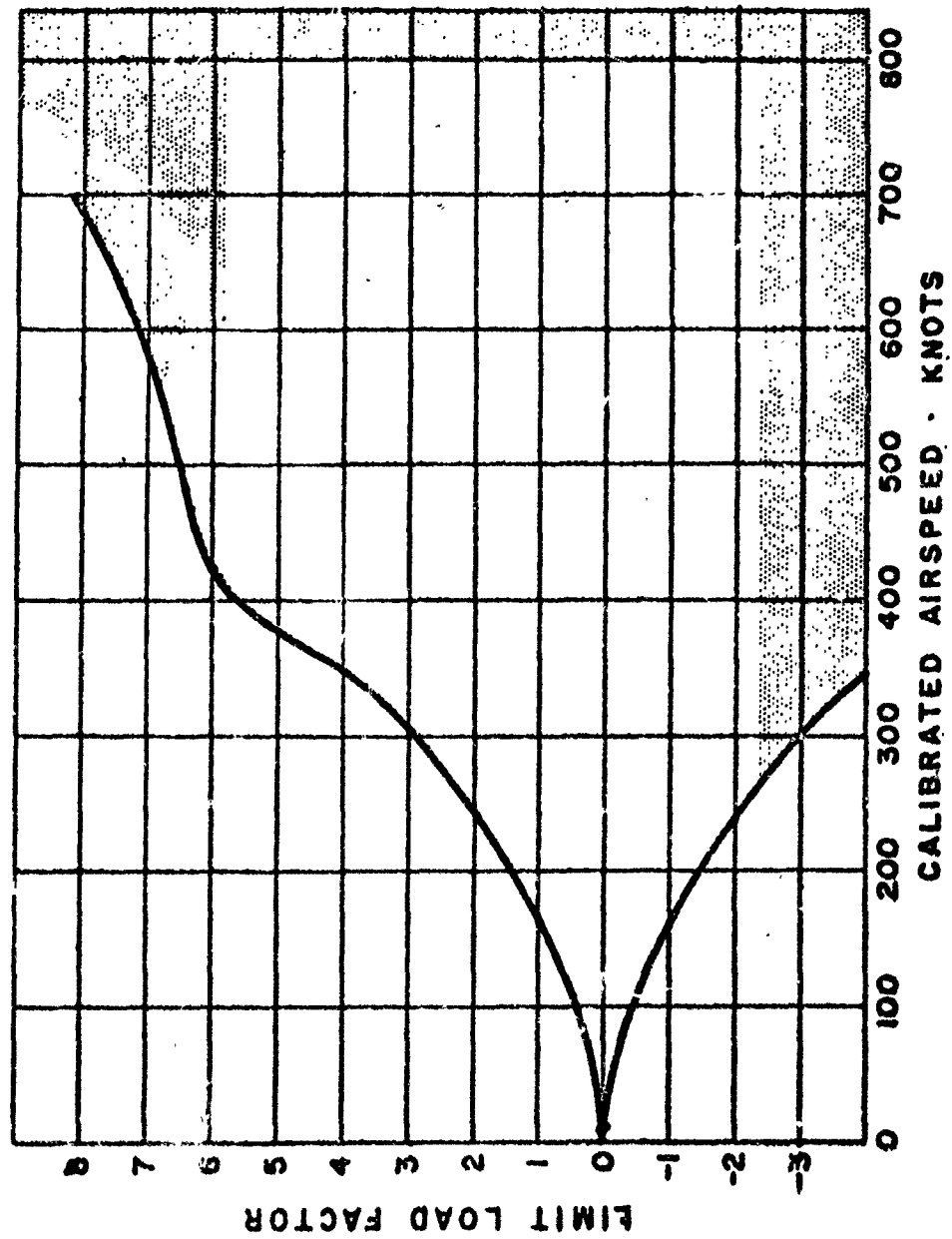


**CONFIDENTIAL**

**CONFIDENTIAL**

CONFIDENTIAL

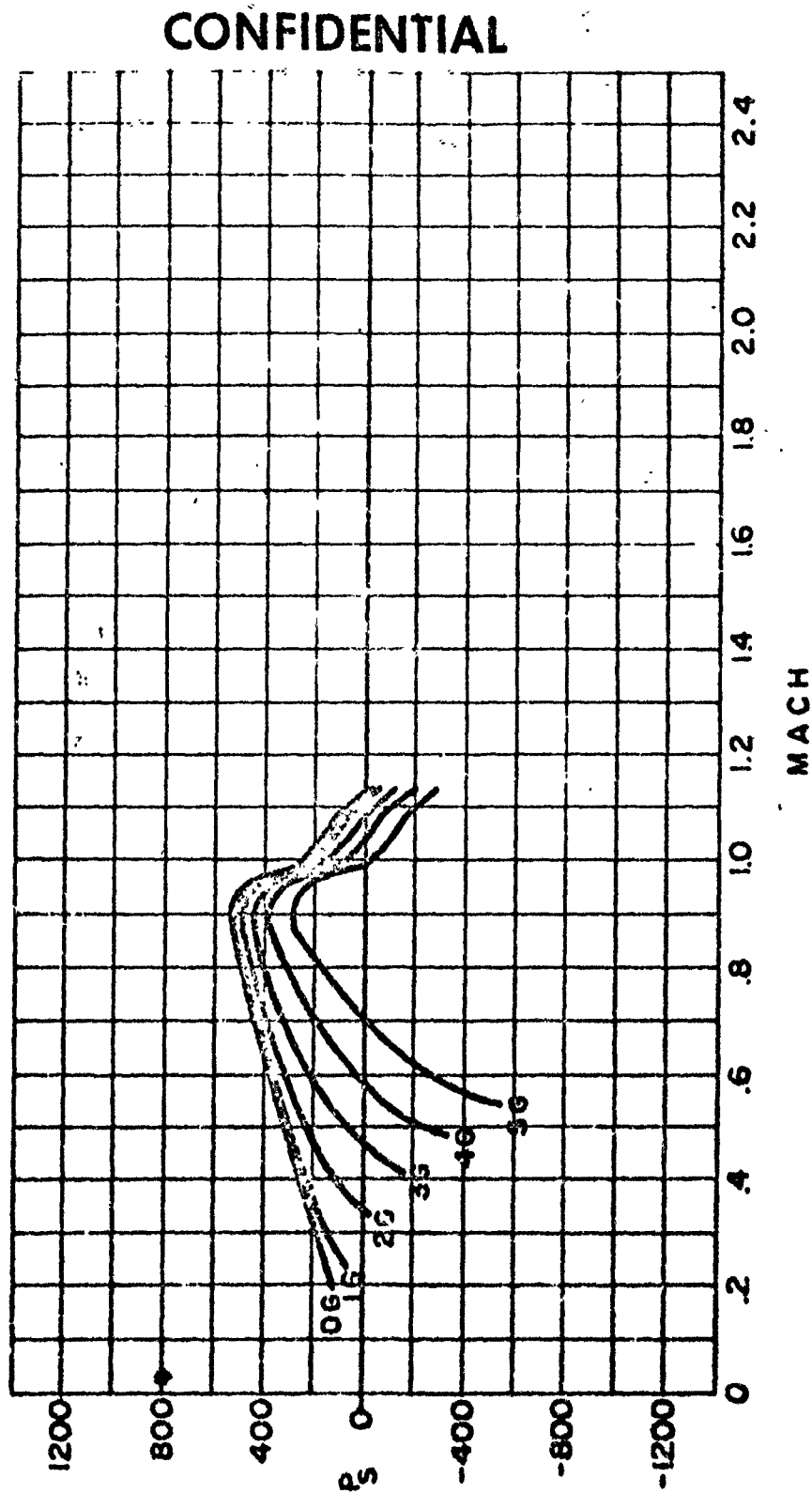
FLIGHT OPERATING LIMITS • F-105D • 30,000'



CONFIDENTIAL

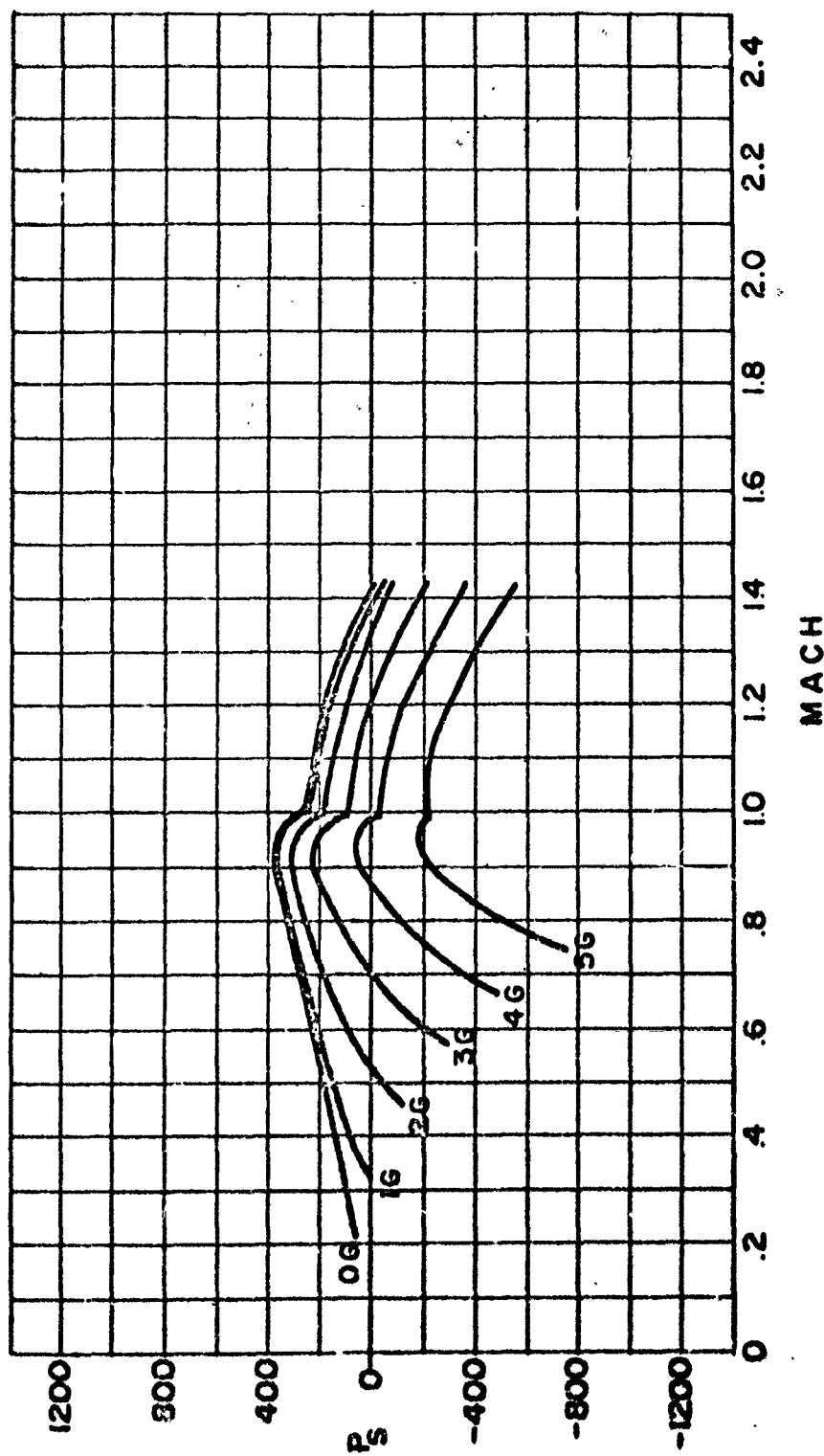
MAXIMUM POWER · SEA LEVEL F-105D

100



# MAXIMUM POWER · 15,000'

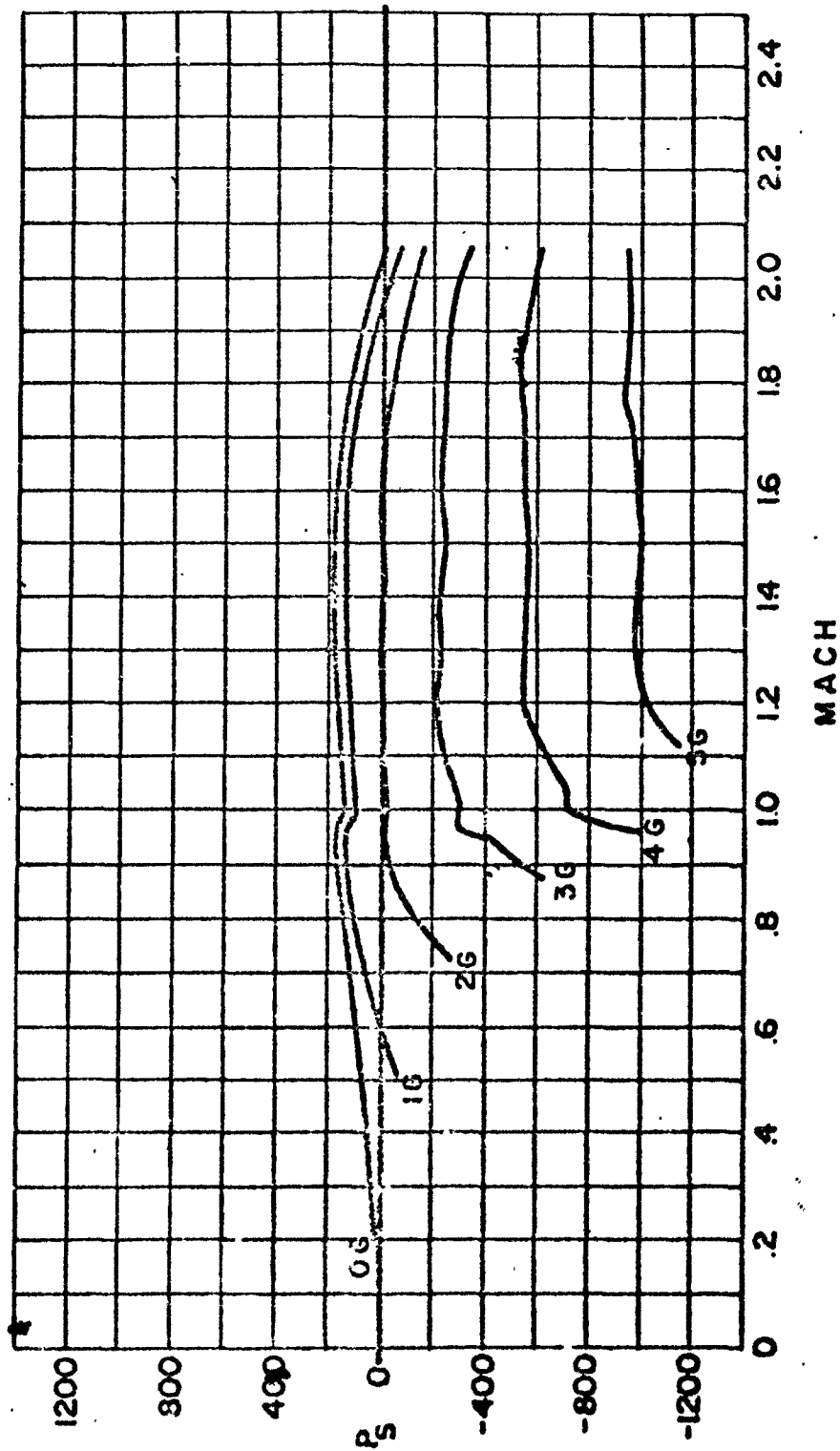
F-105D



MAXIMUM POWER · 35,000'

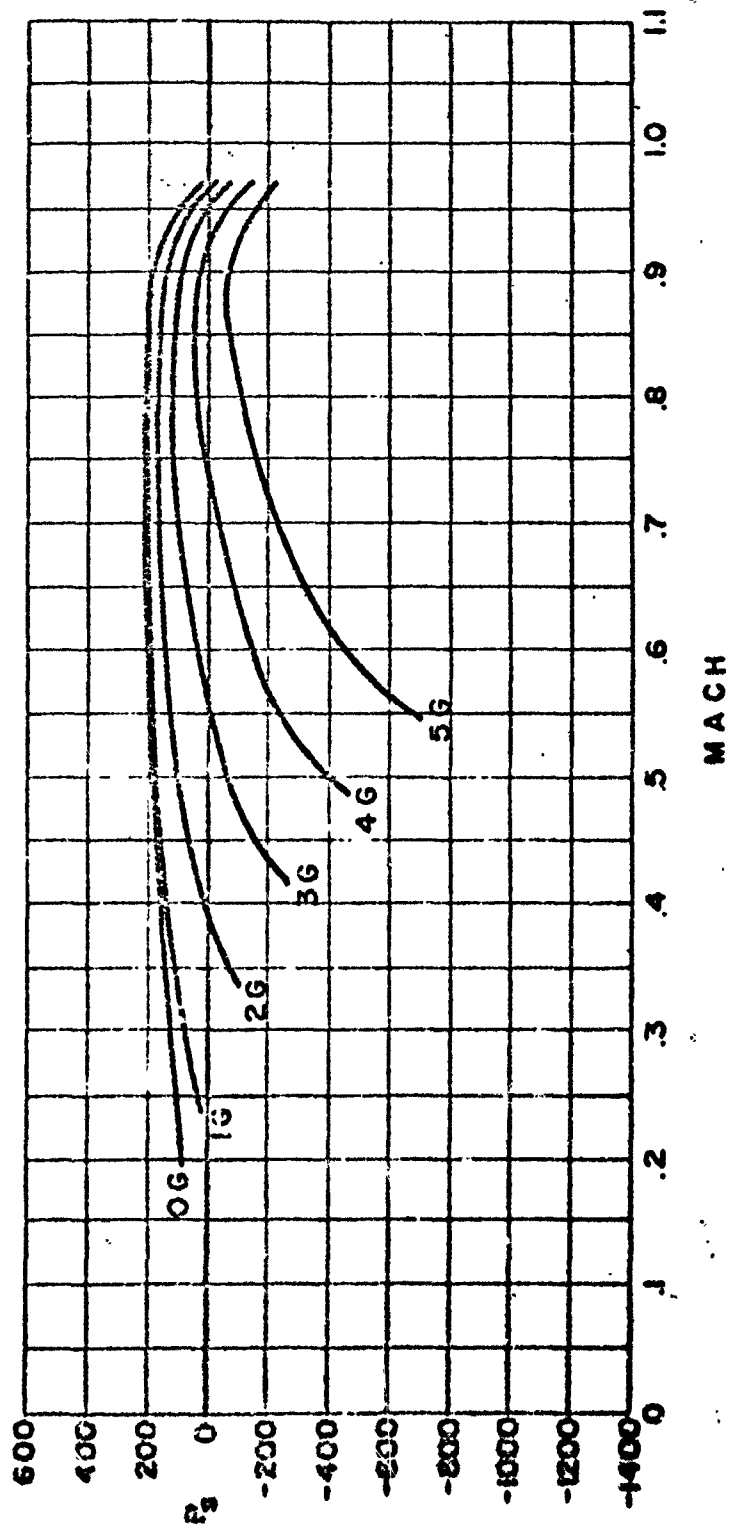
F-105D

102



# MILITARY POWER · SEA LEVEL

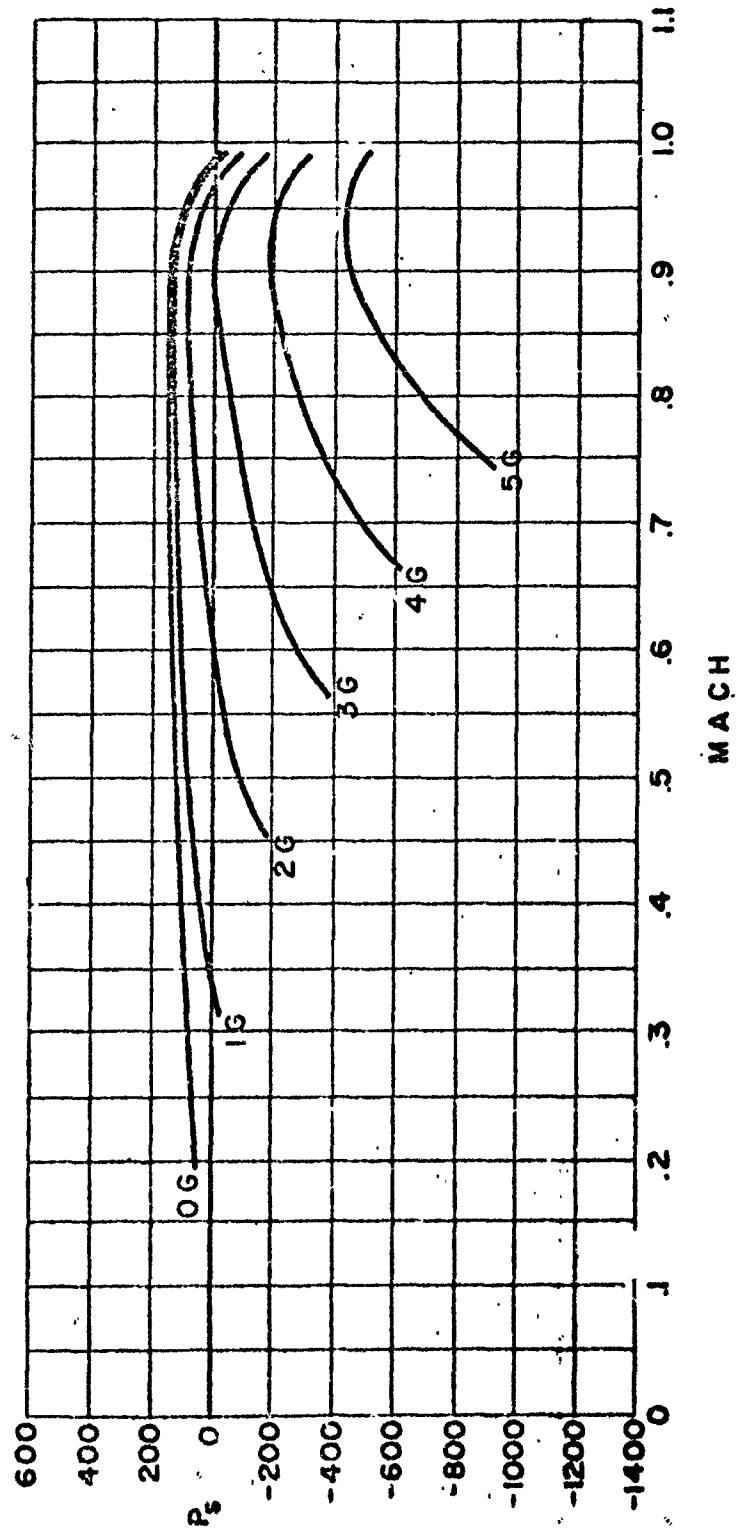
F-105D





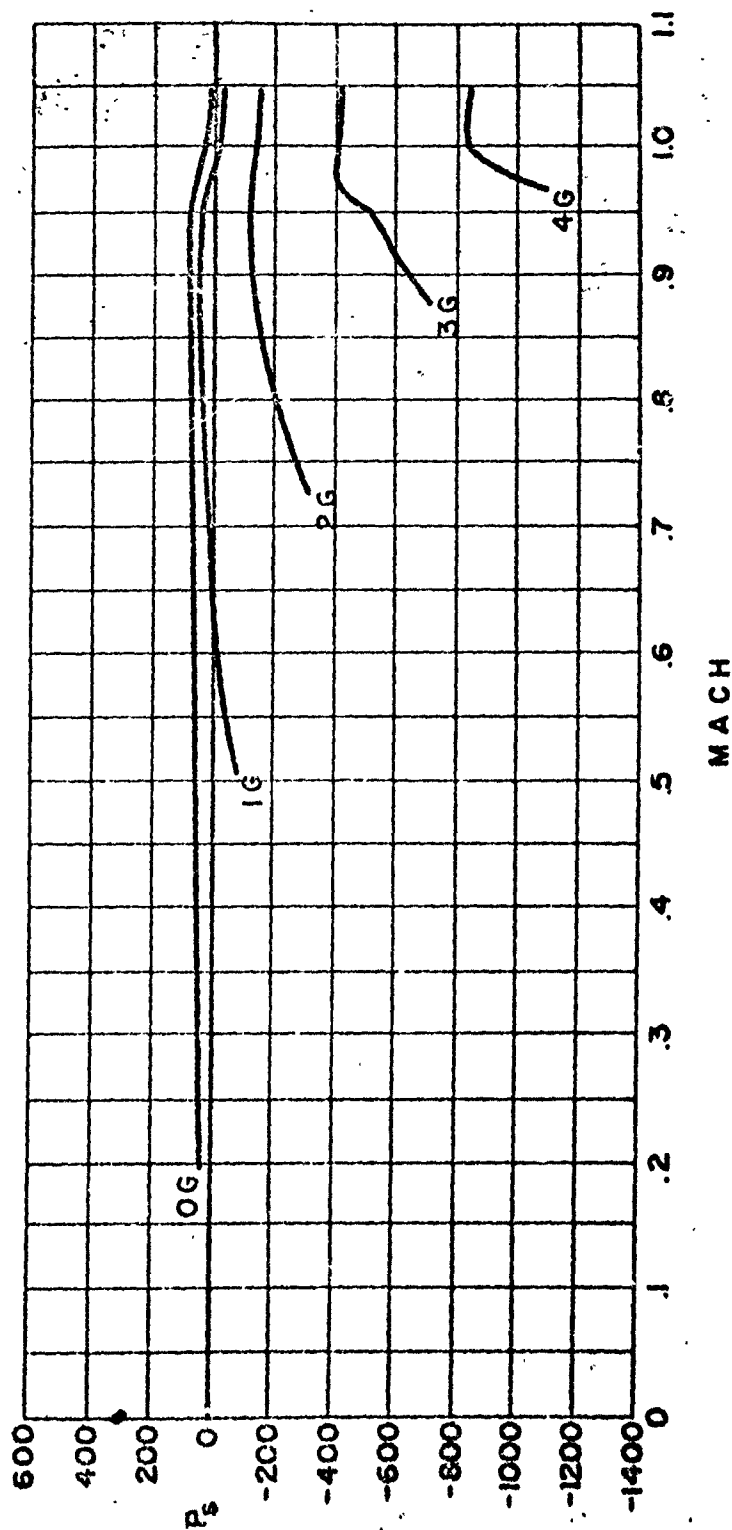
# MILITARY POWER · 15,000'

F-105D



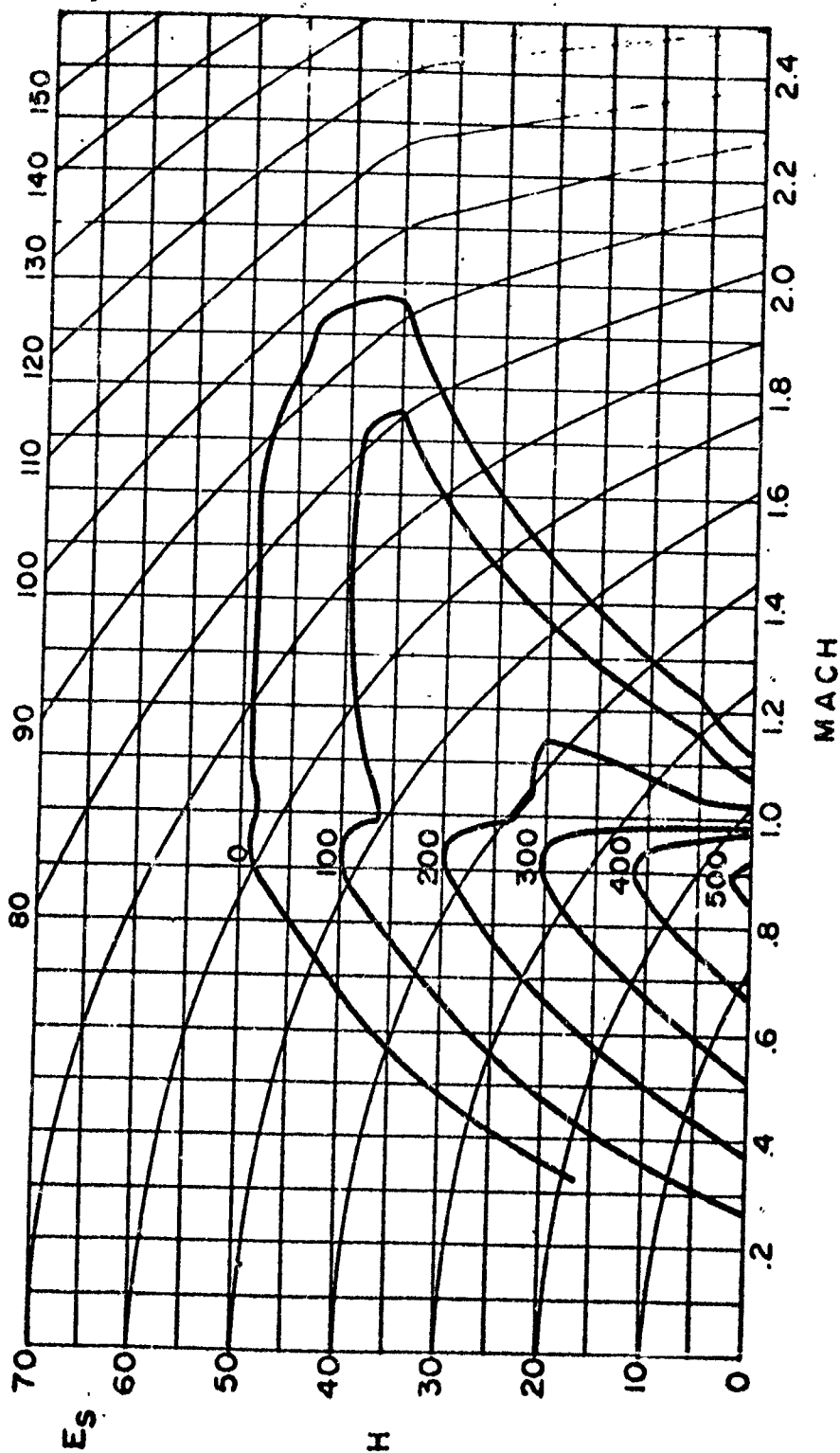
# MILITARY POWER · 35,000'

F-105D



MAXIMUM POWER · IG

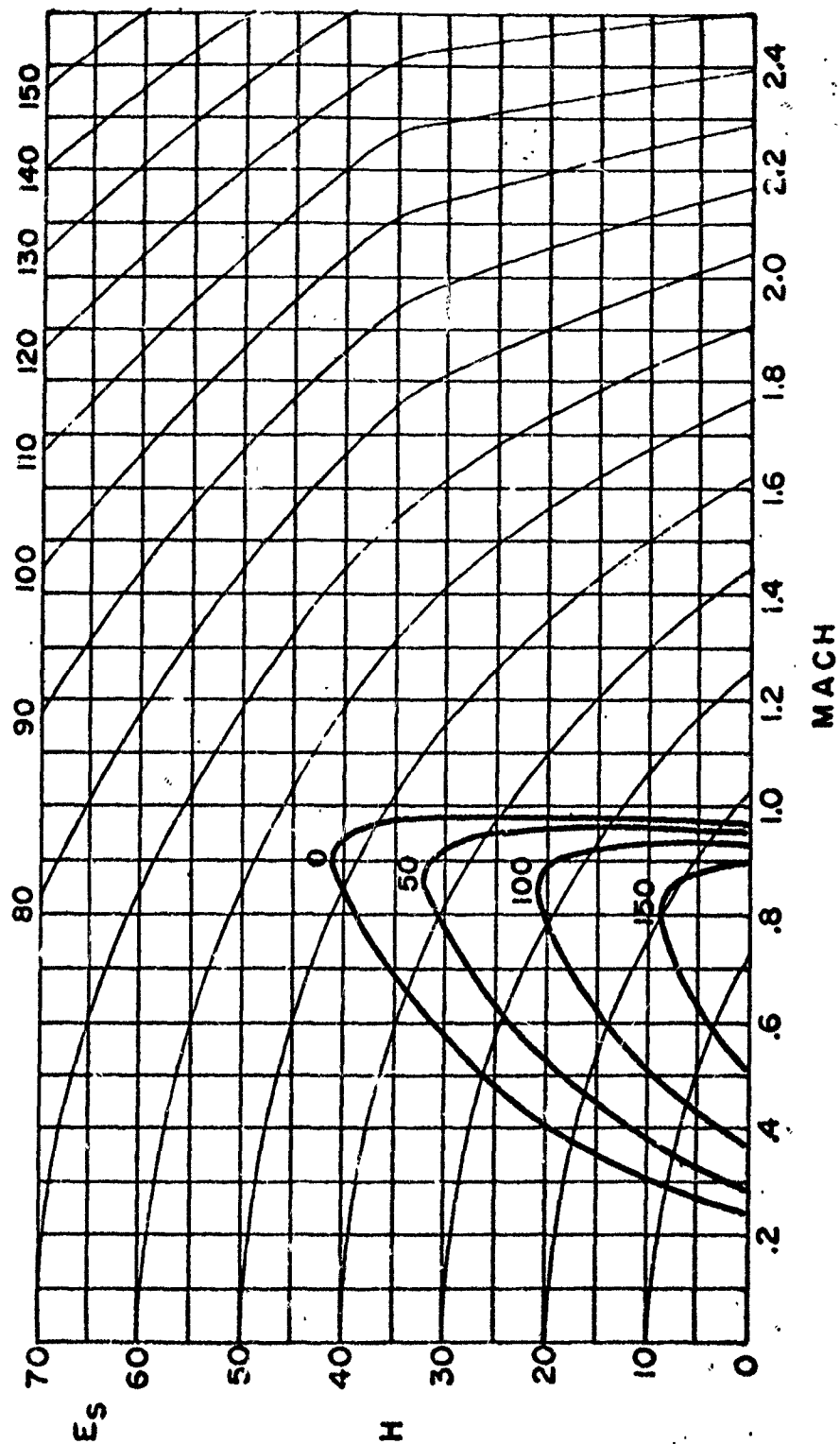
F-105D



CONFIDENTIAL

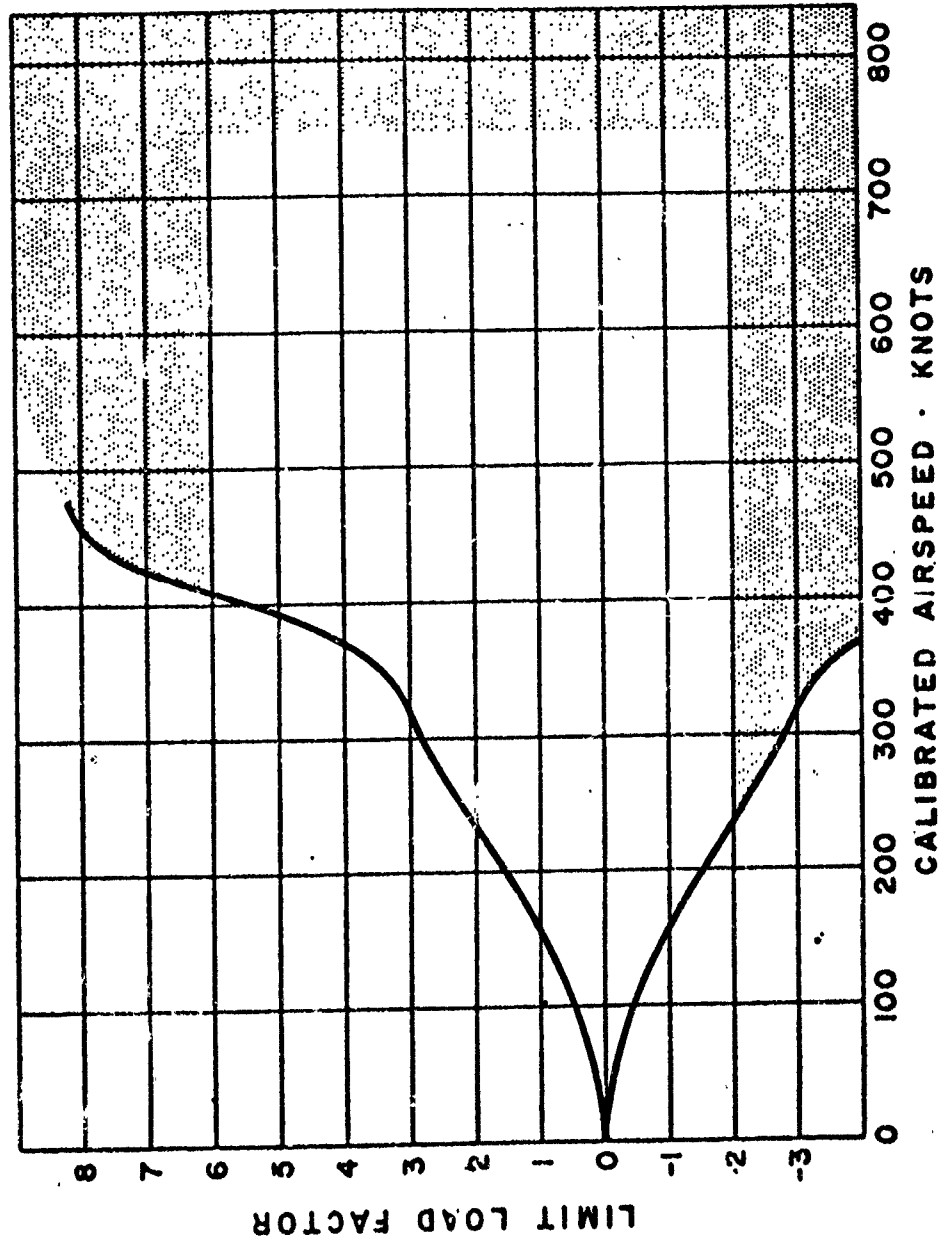
## MILITARY POWER · IG

F-105D



CONFIDENTIAL

FLIGHT OPERATING LIMITS • F-4C • 30,000'

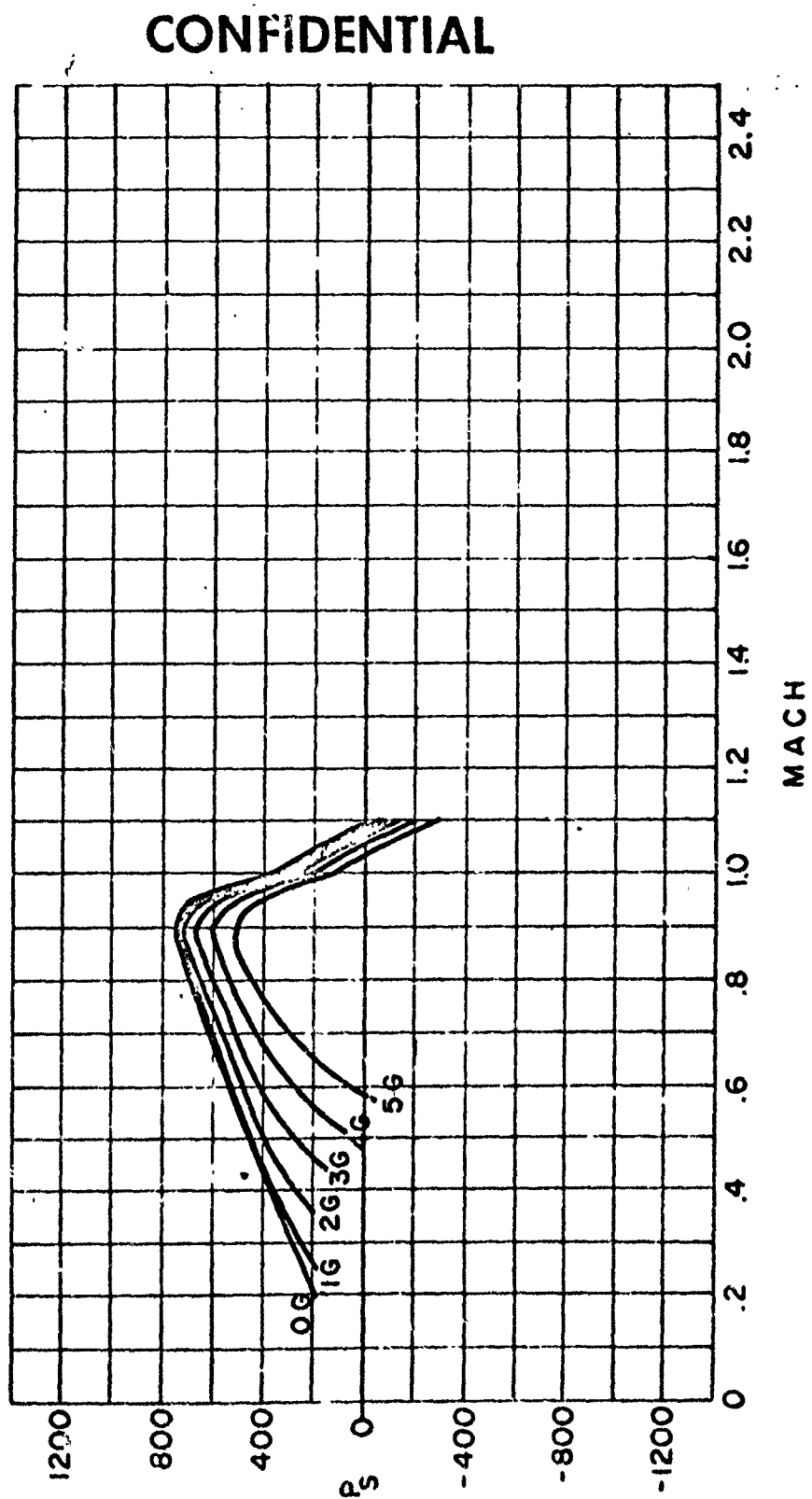


CONFIDENTIAL

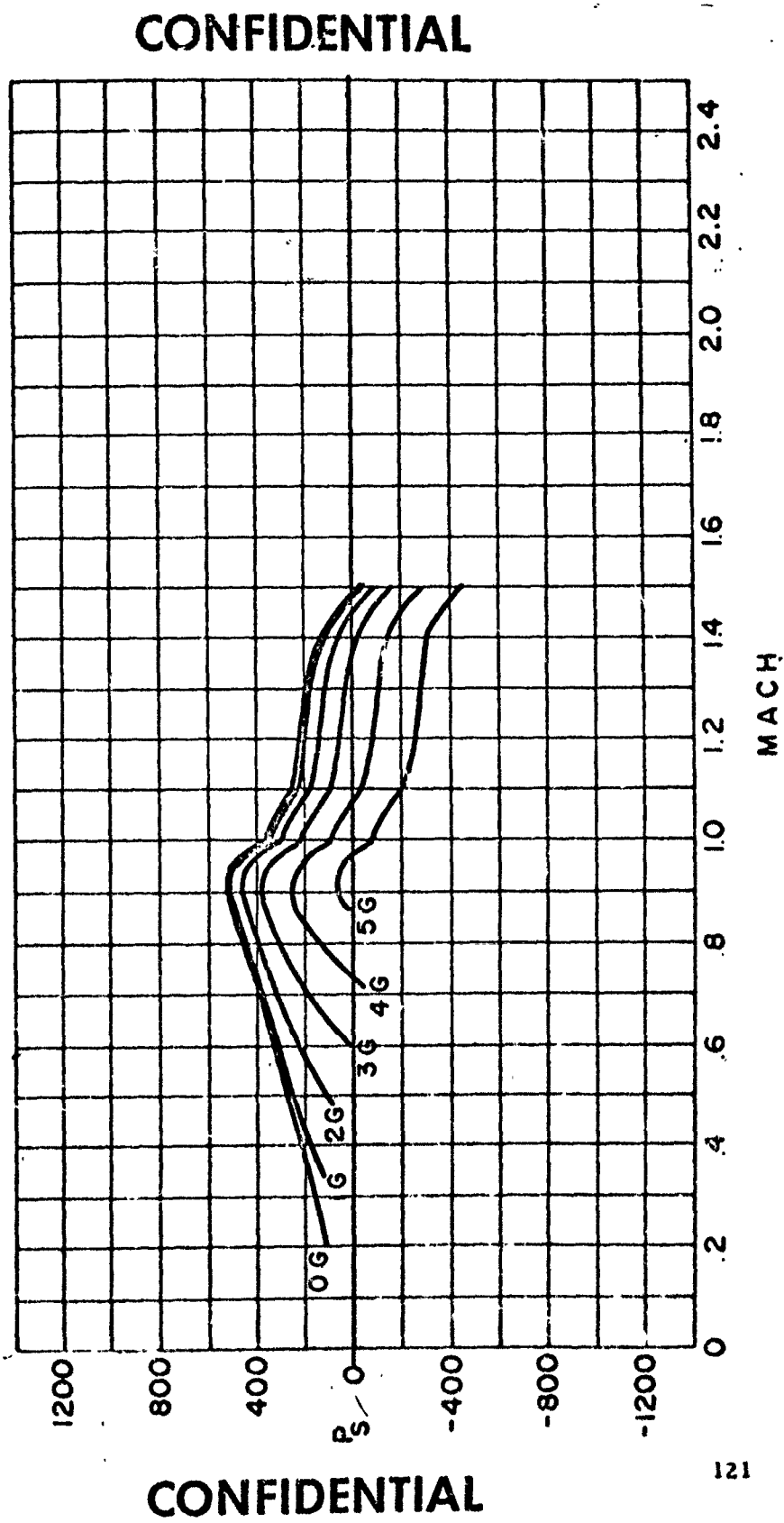
C

**MAXIMUM POWER · SEA LEVEL F-4C**

120

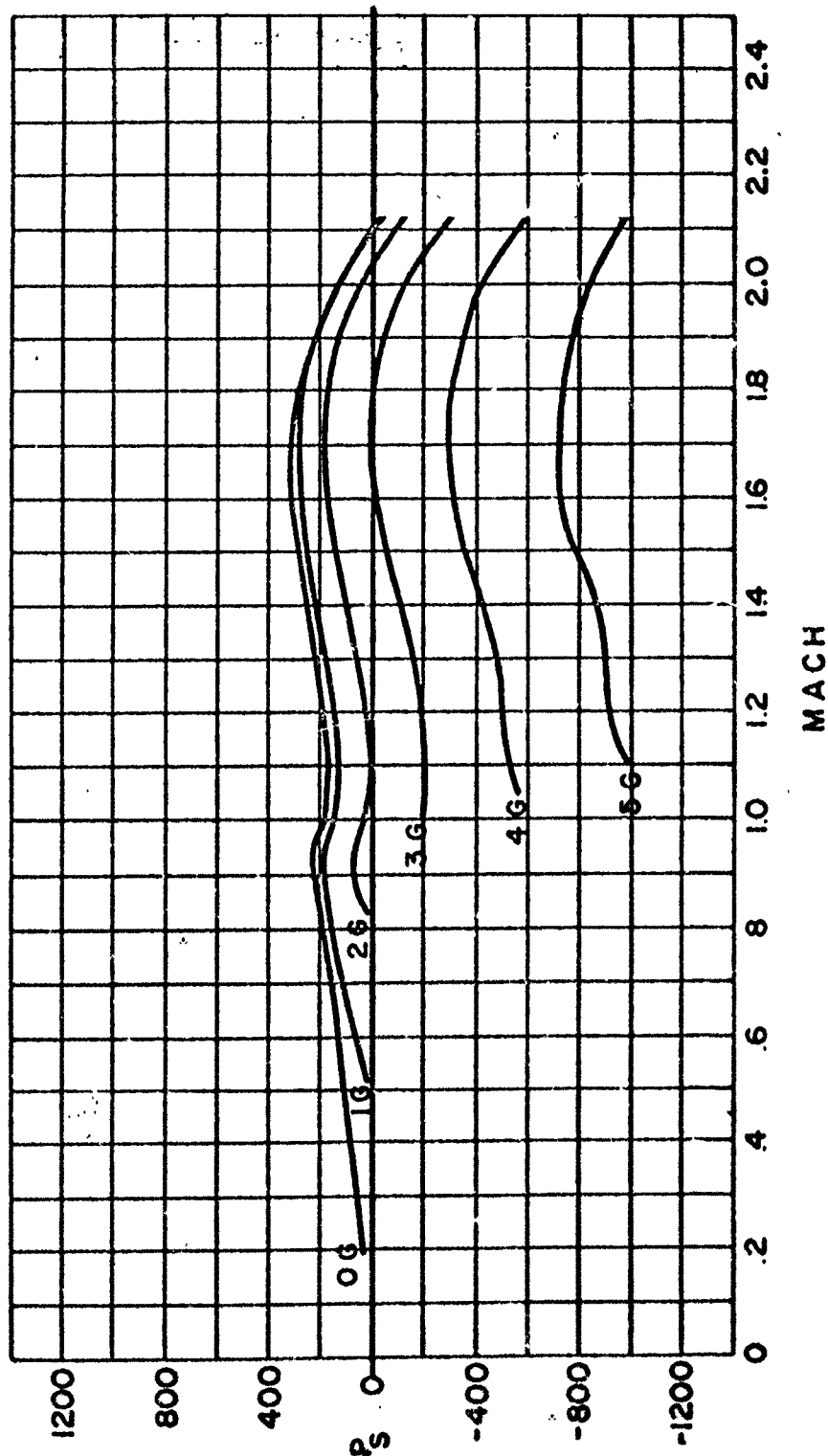


**MAXIMUM POWER · 15,000' F-4C**



122

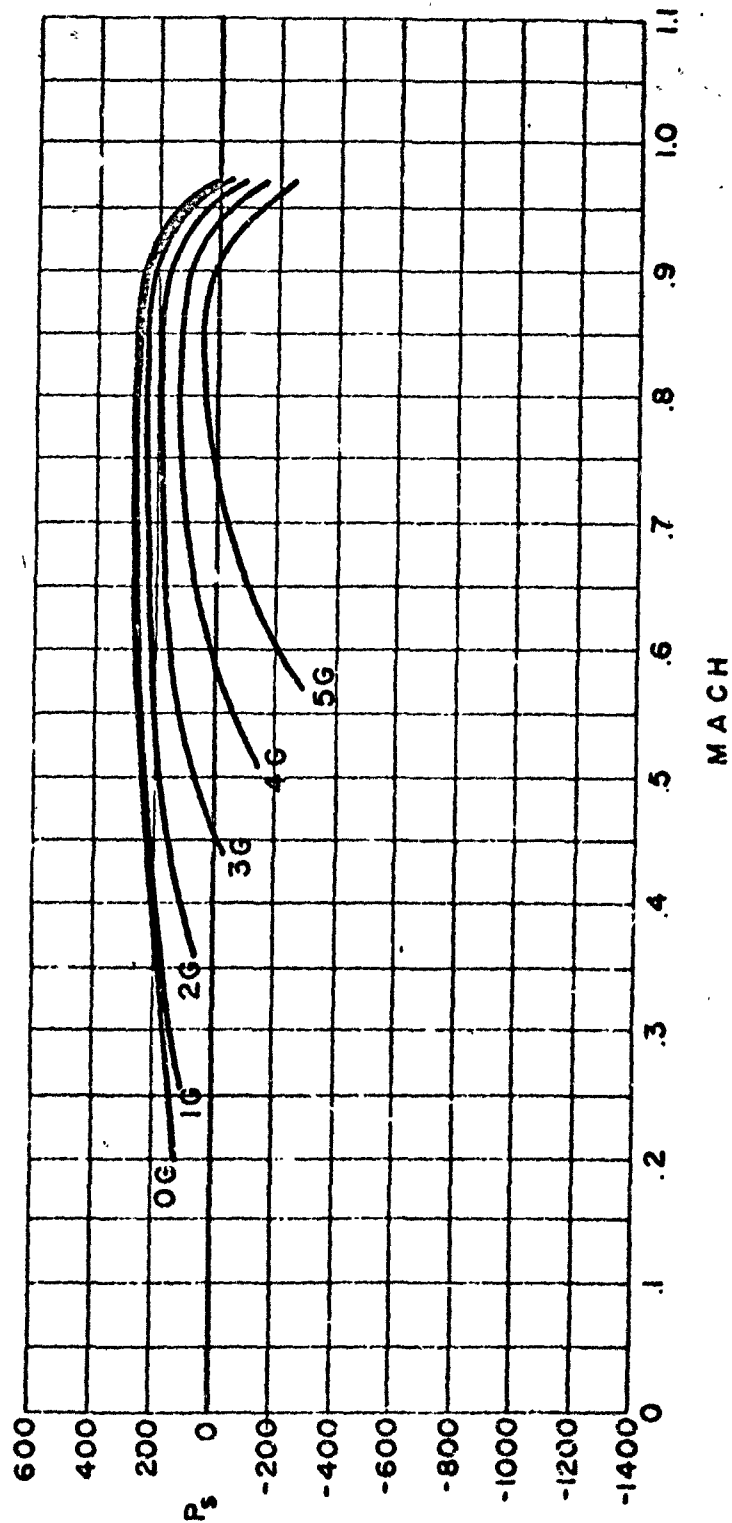
**CONFIDENTIAL**





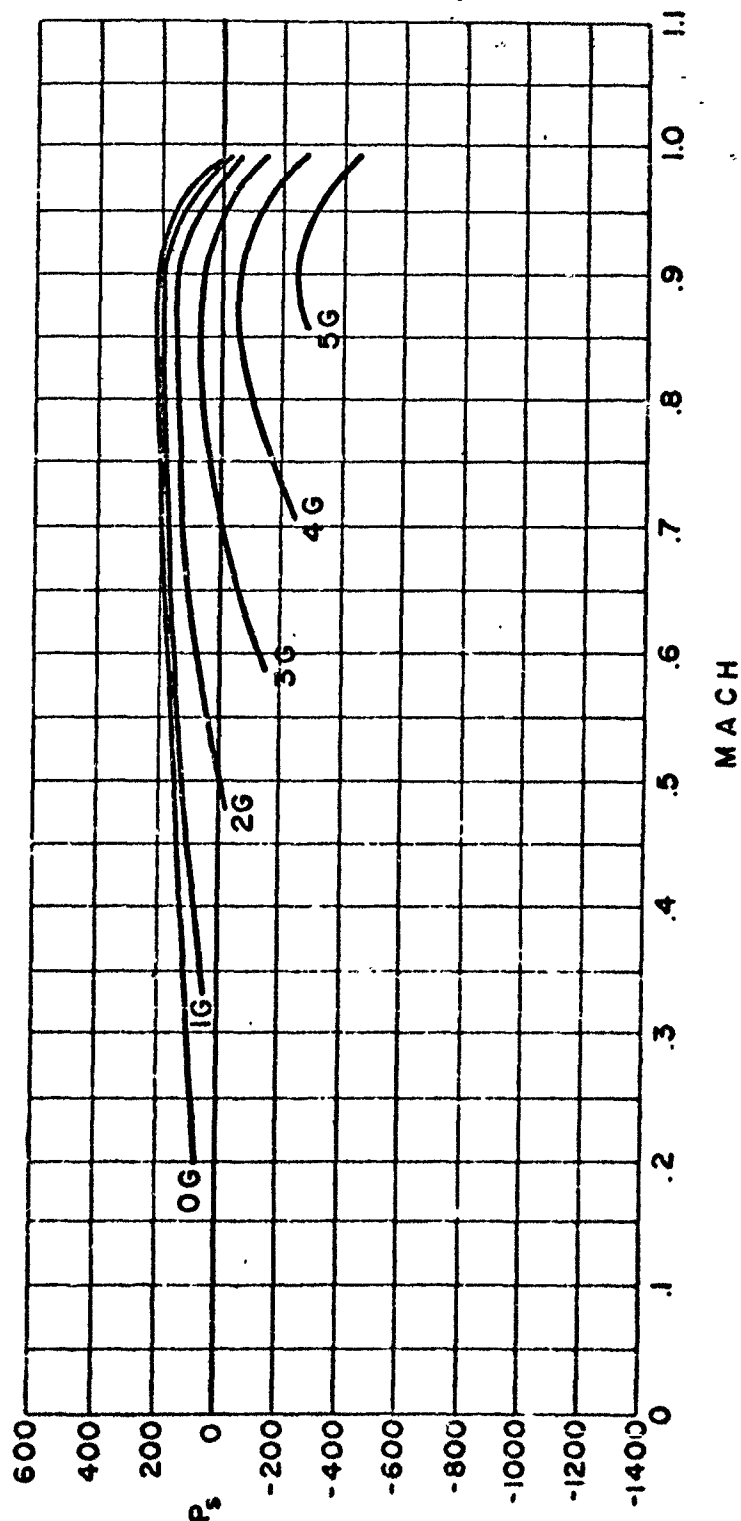
# MILITARY POWER · SEA LEVEL

F-4C



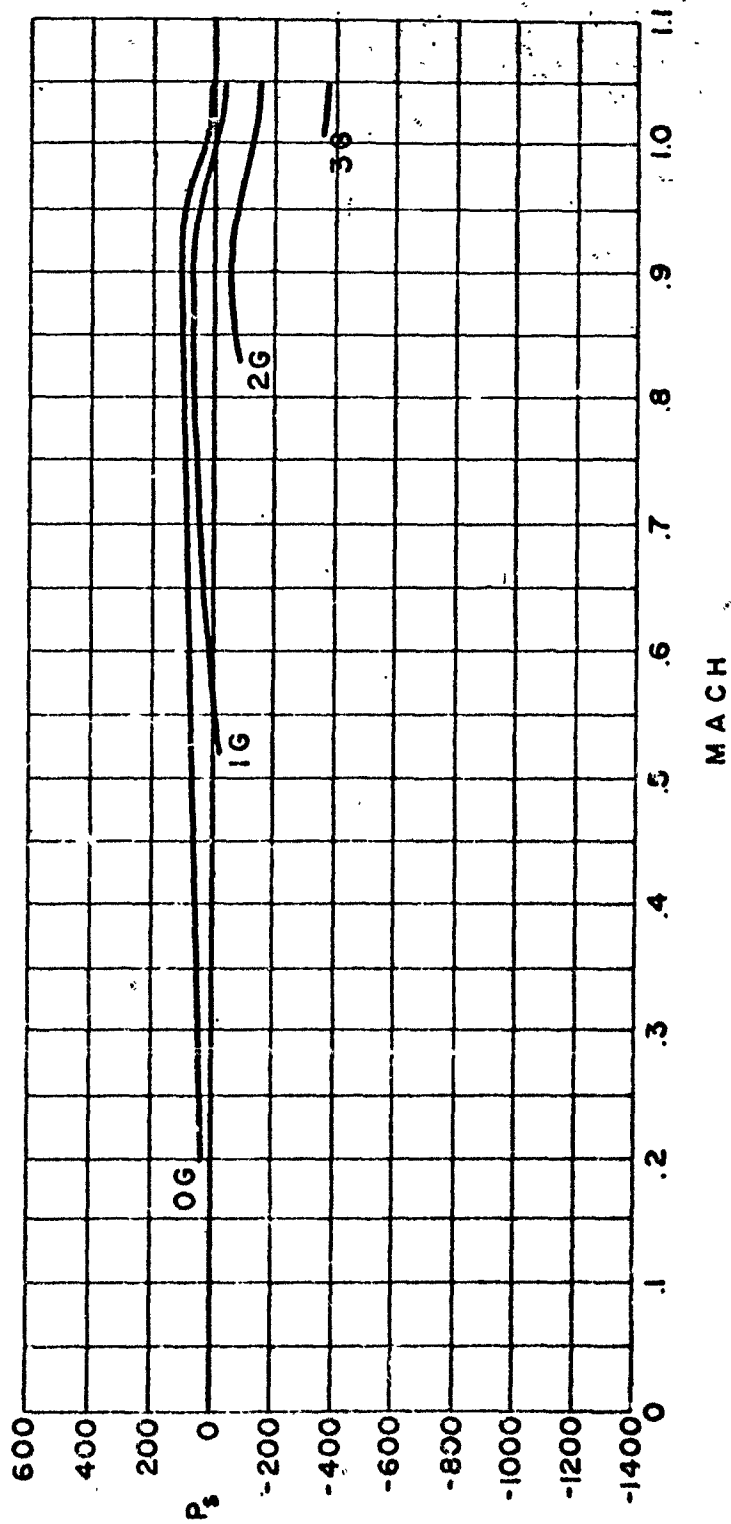
# MILITARY POWER - 15,000'

F-4C



# MILITARY POWER · 35,000'

F-4C



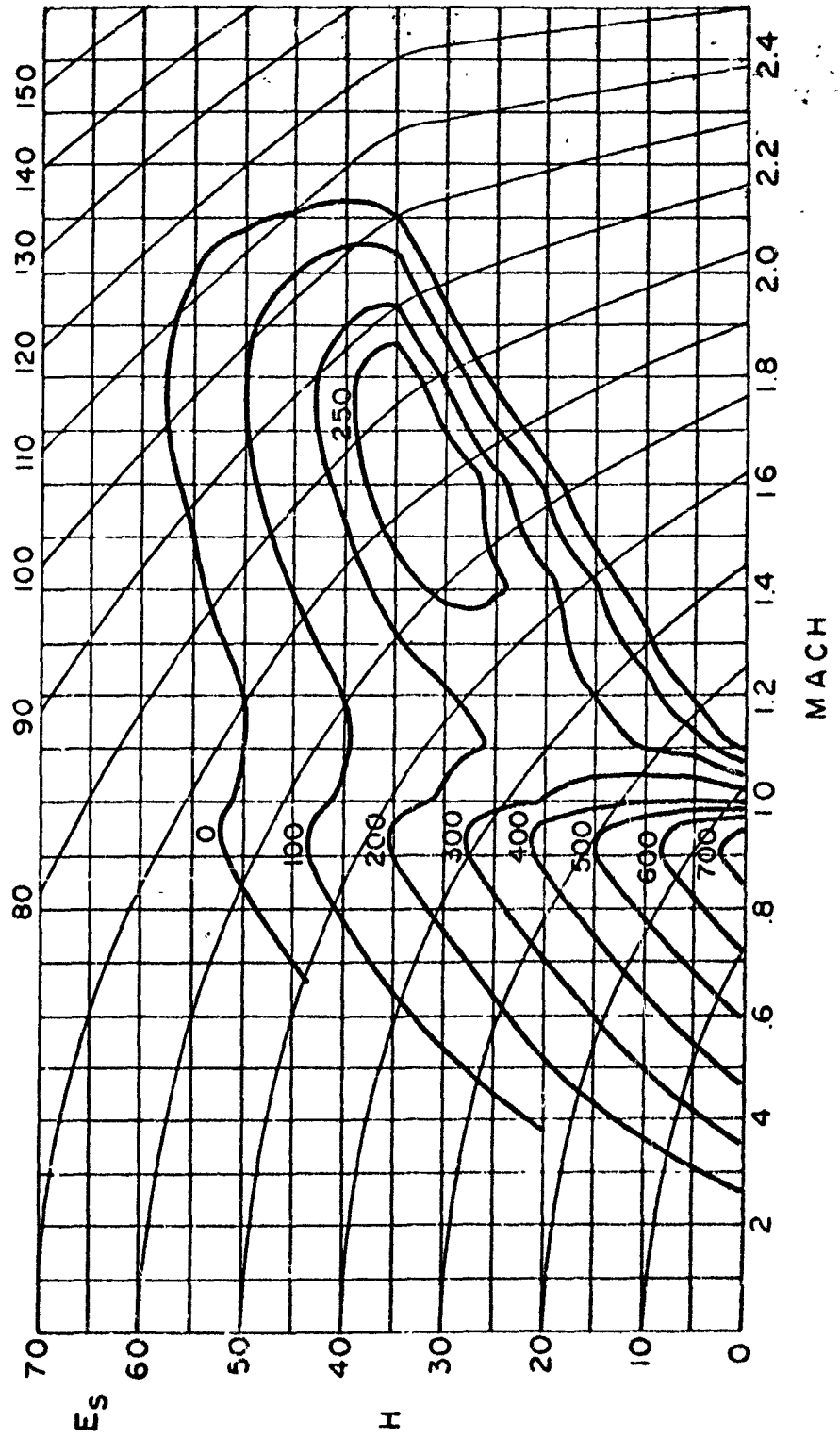
CONFIDENTIAL

CONFIDENTIAL

F-4C

MAXIMUM POWER · IG

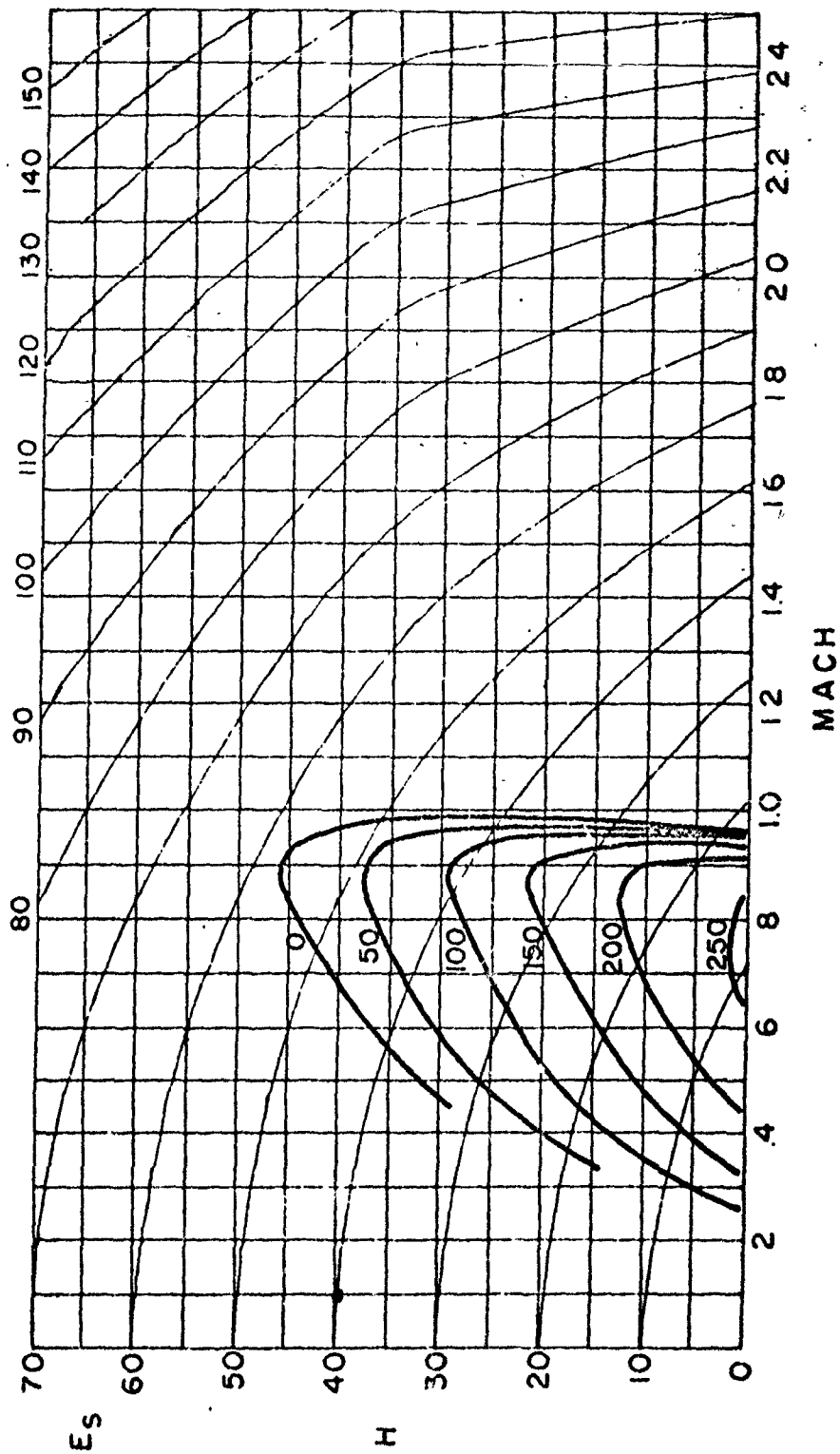
126



CONFIDENTIAL

MILITARY POWER · IG

F-4C



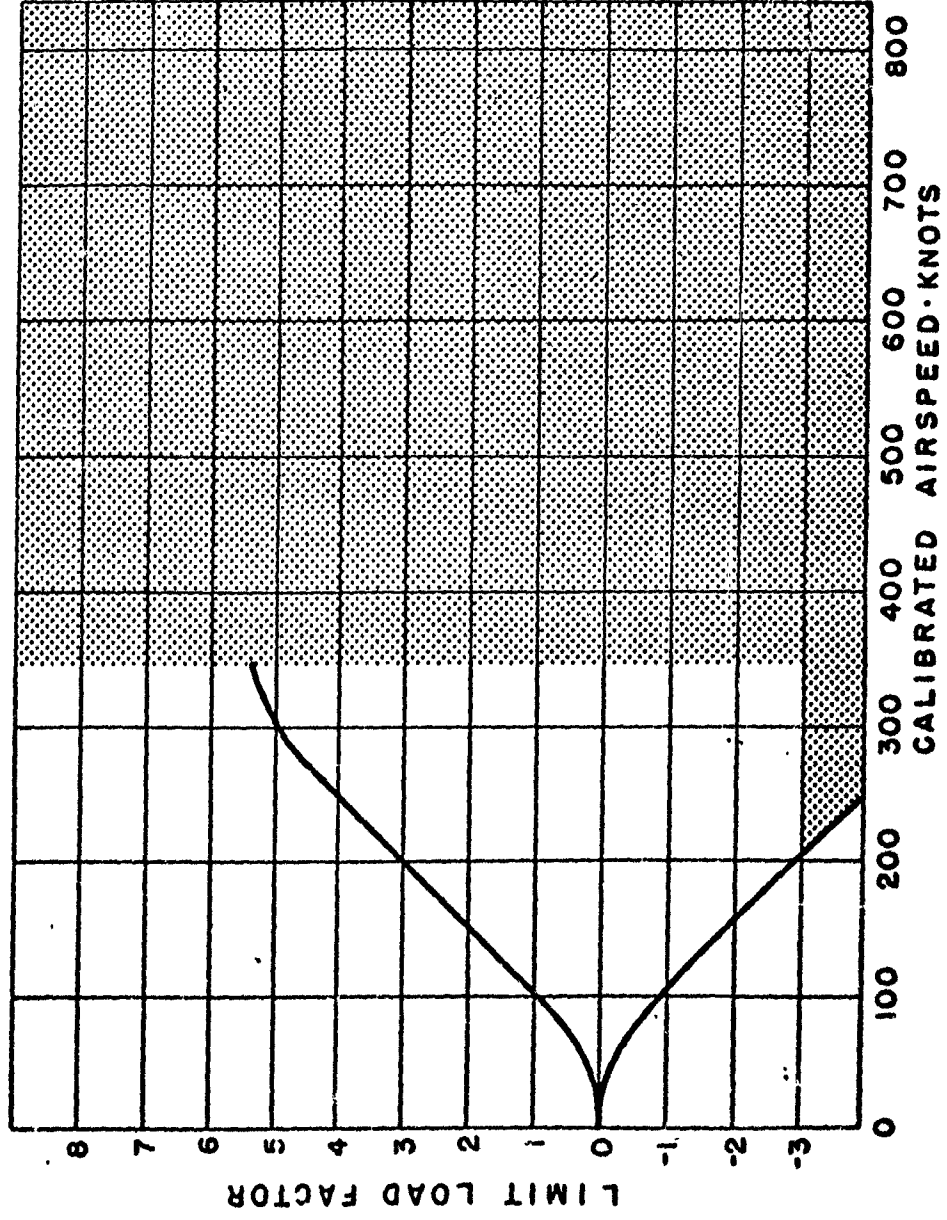
CONFIDENTIAL

CONFIDENTIAL

SECRET

# FLIGHT OPERATING LIMITS 30,000'

MIG-15



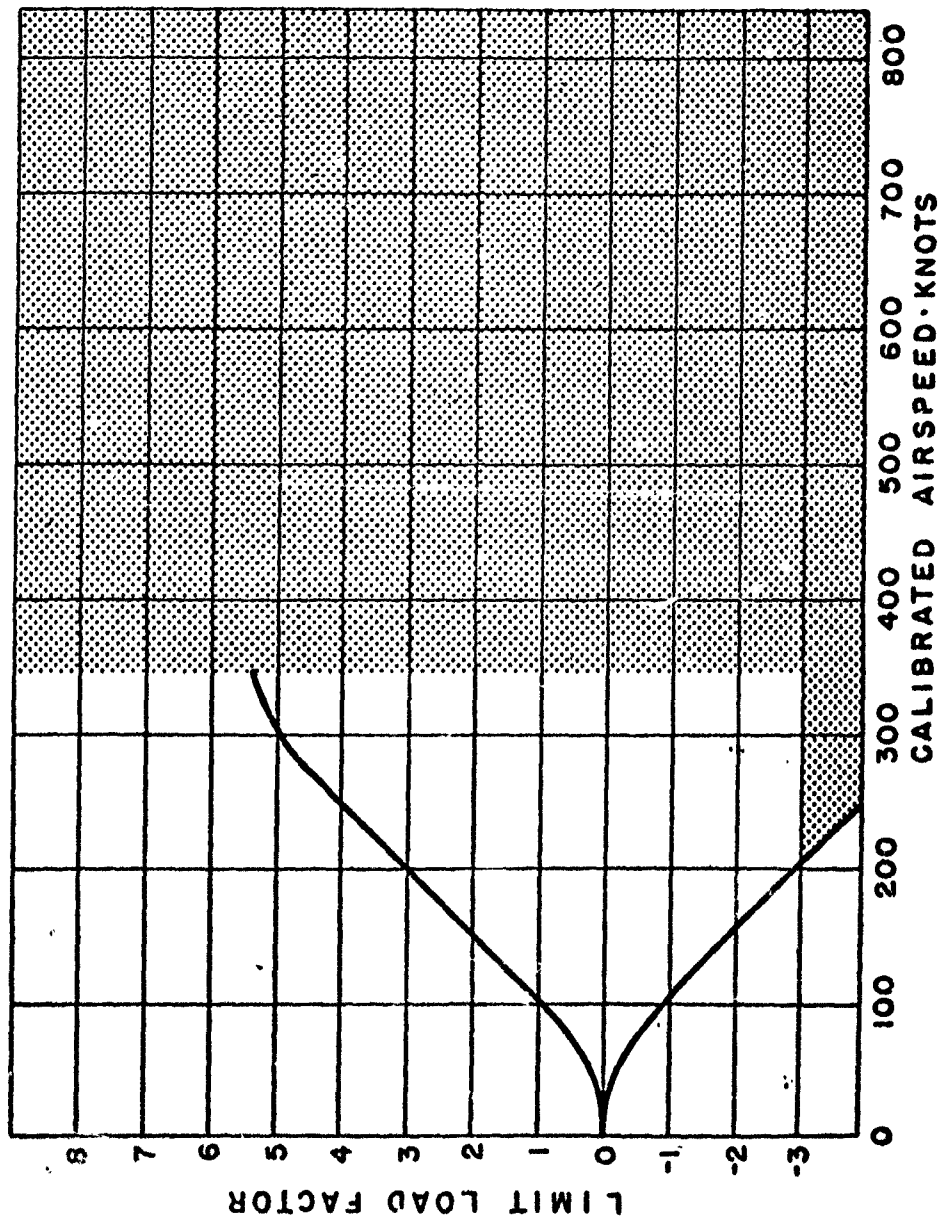
SECRET

SECRET

# FLIGHT OPERATING LIMITS

30,000'

MIG-15

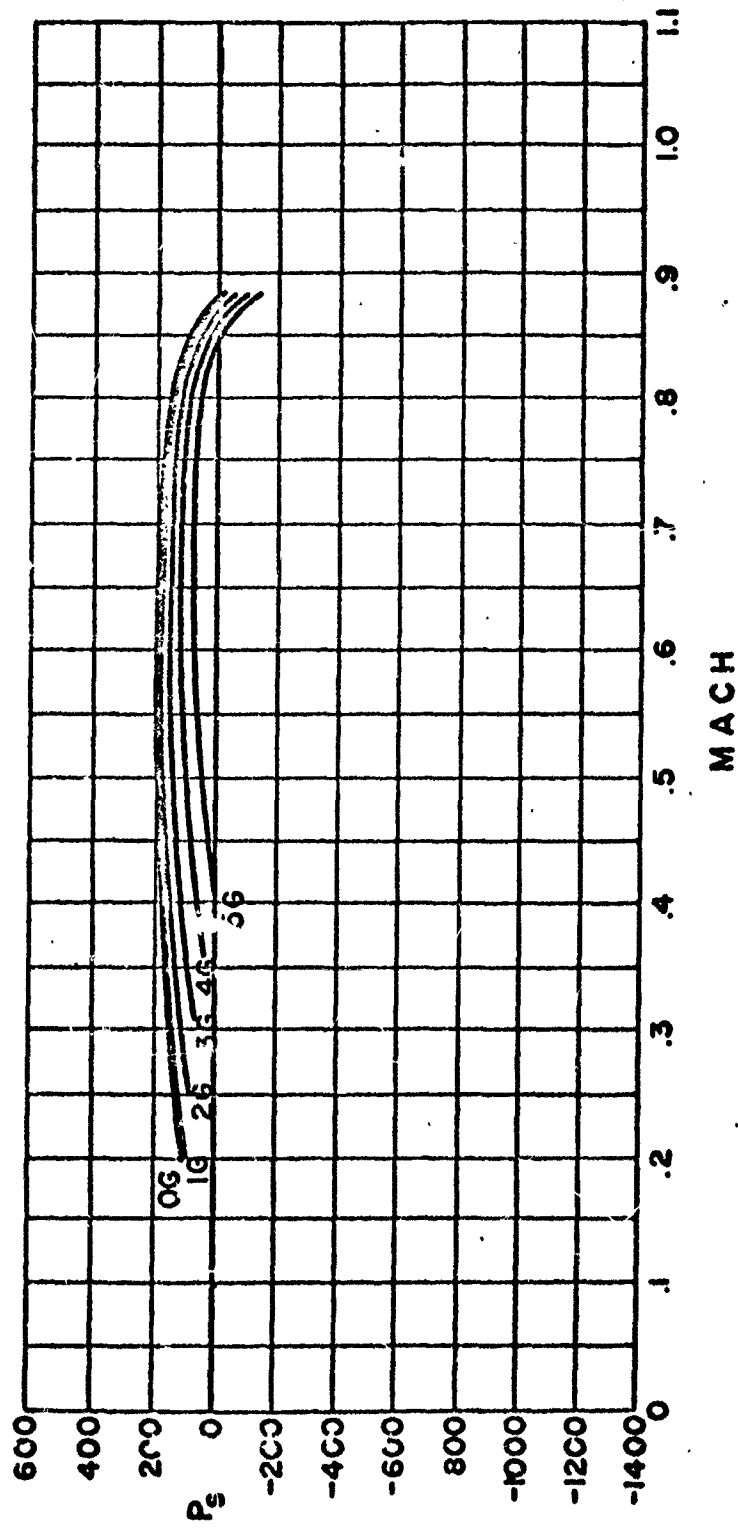


SECRET

SECRET

# MILITARY POWER - SEA LEVEL

MIG-15



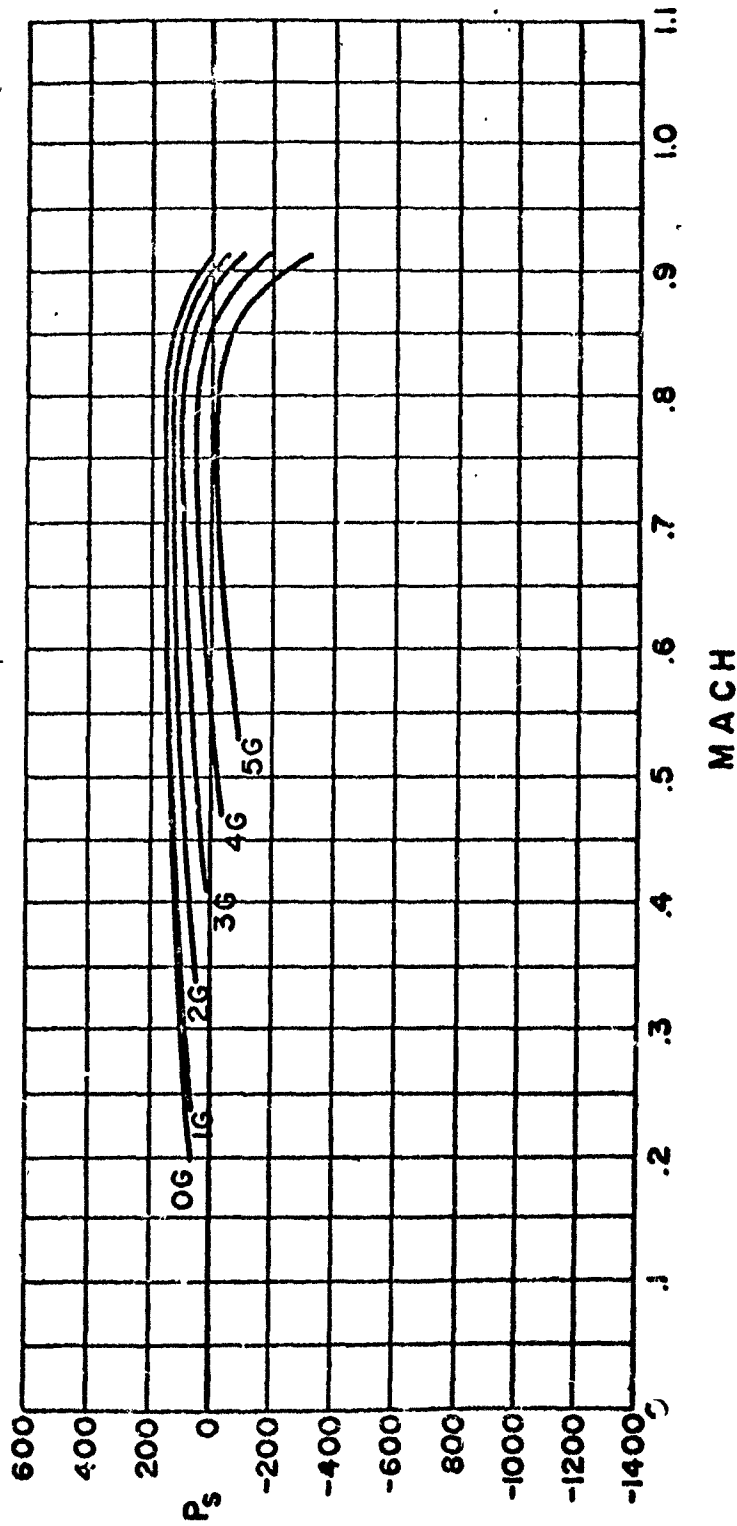
SECRET



SECRET

MILITARY POWER · 15,000'

MIG-15

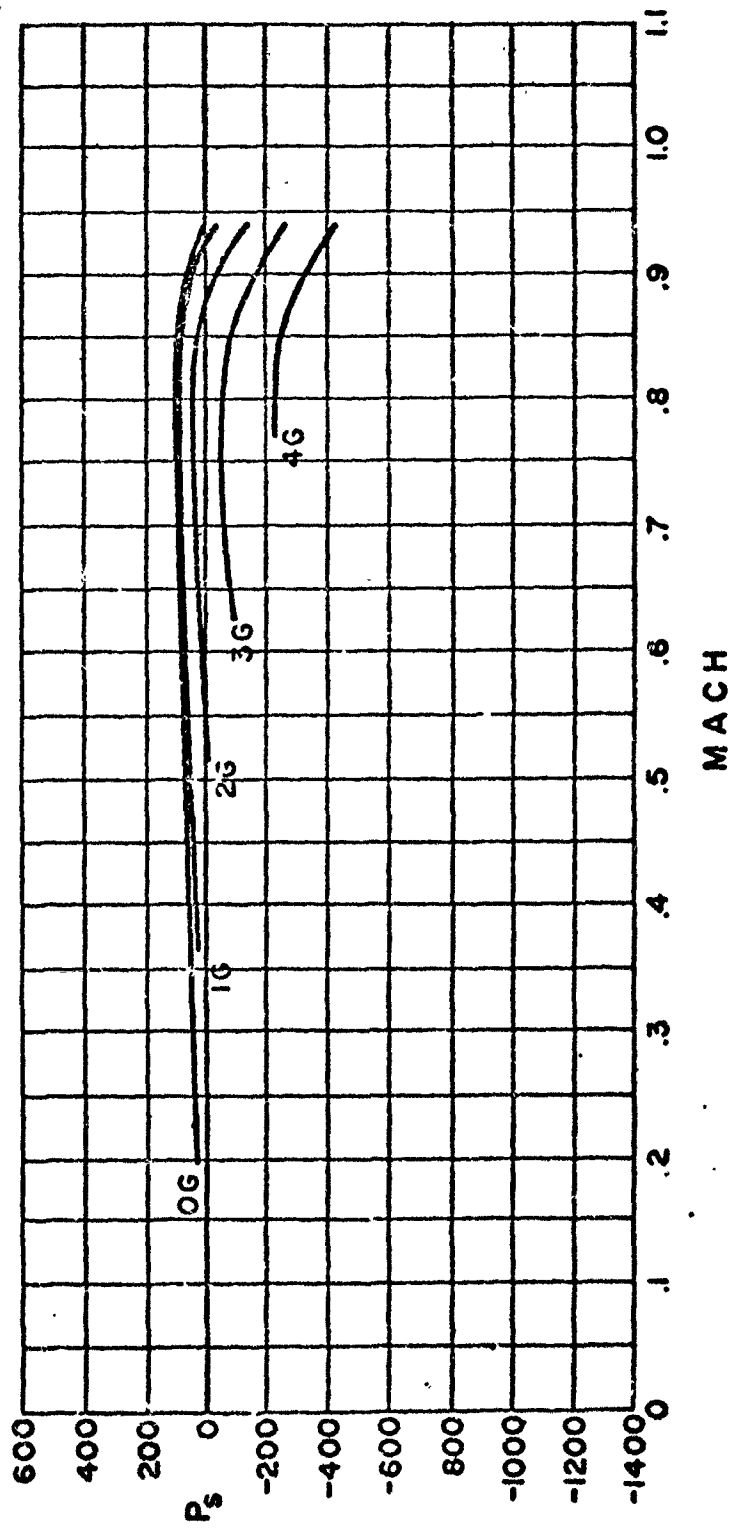


SECRET

SEC ET

MILITARY POWER - 35,000'

MIG-15

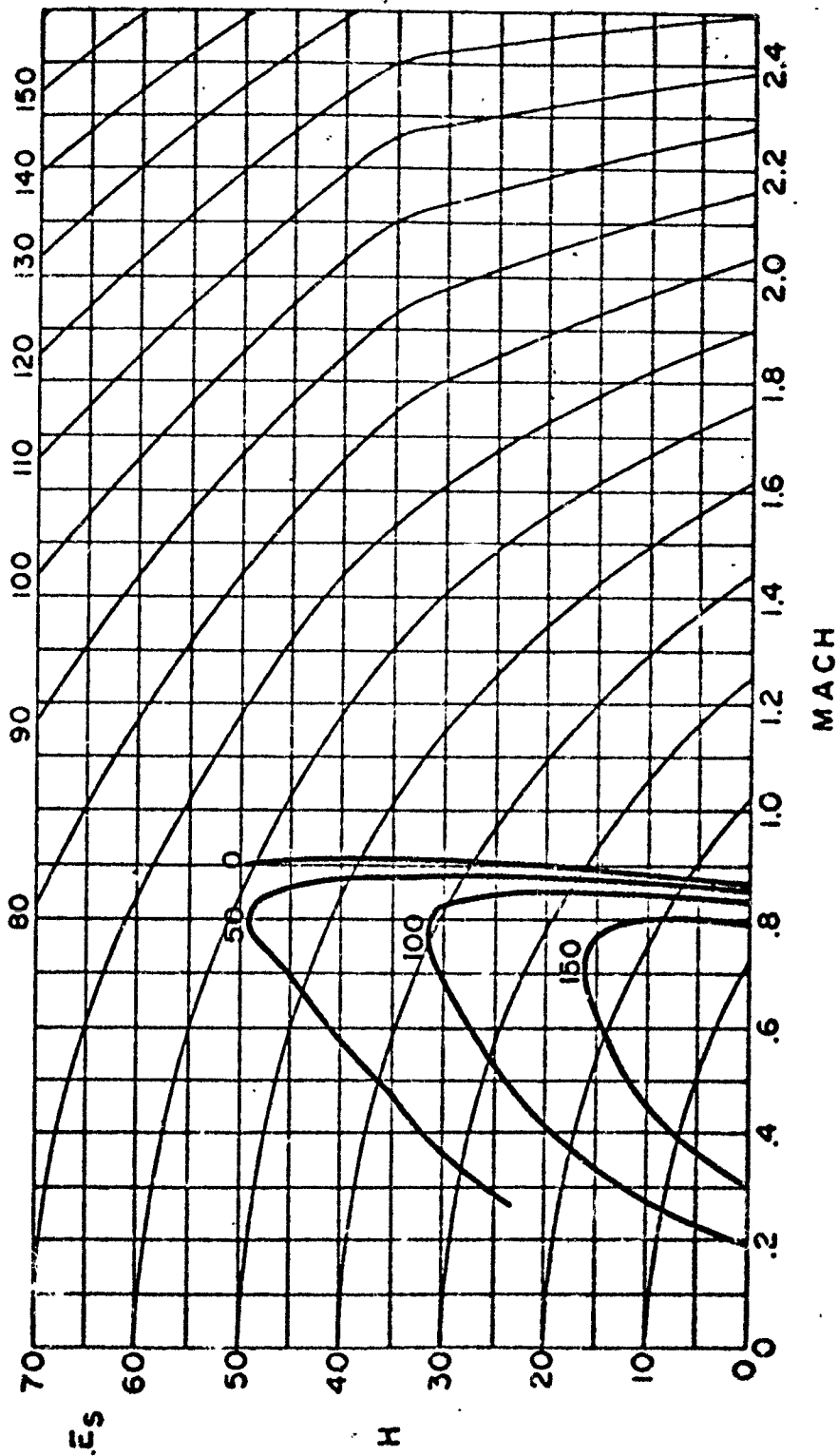


SECRET

SECRET

ENERGY RATE  
MILITARY POWER · IG

MIG-15

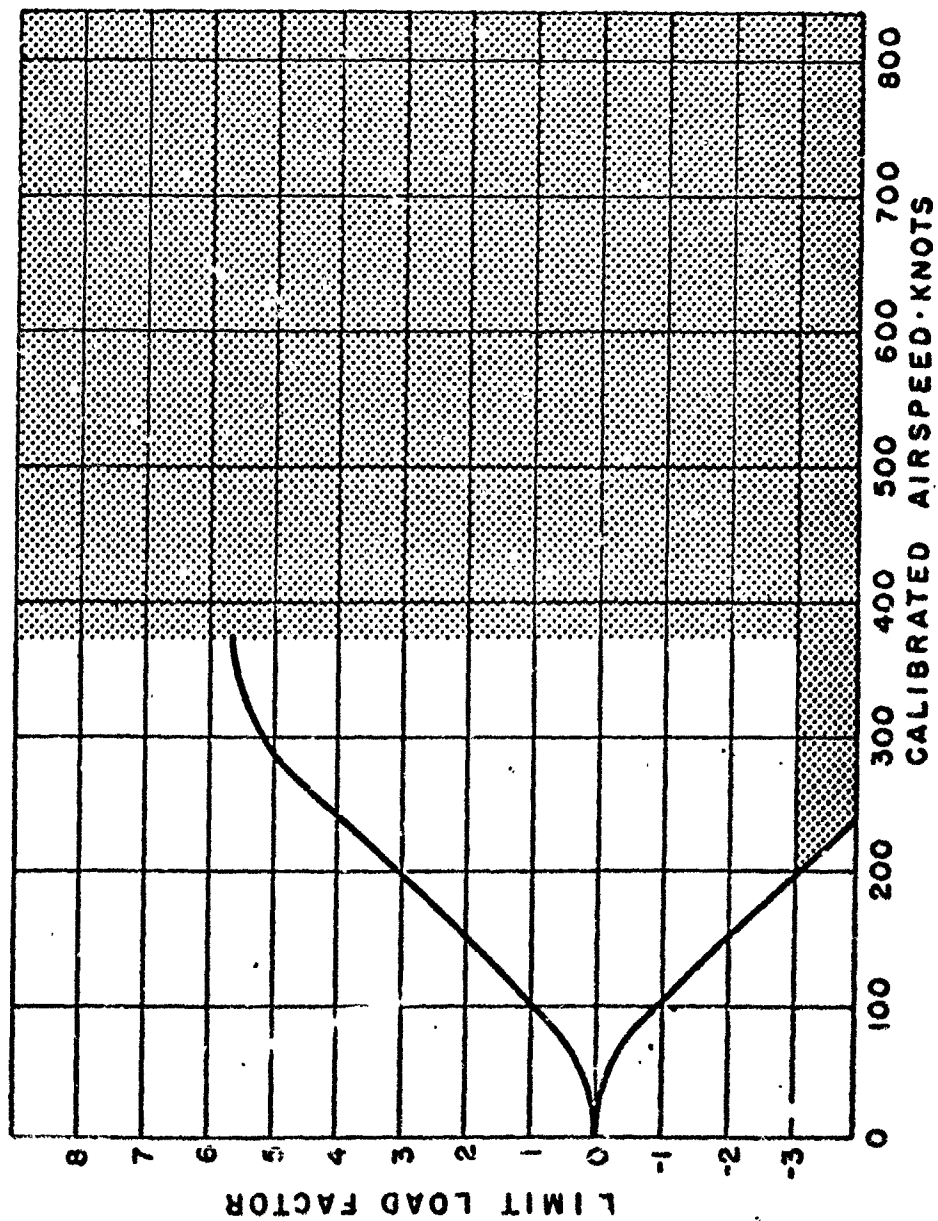


SECRET

SEC IT

# FLIGHT OPERATING LIMITS 30,000'

MIG-17

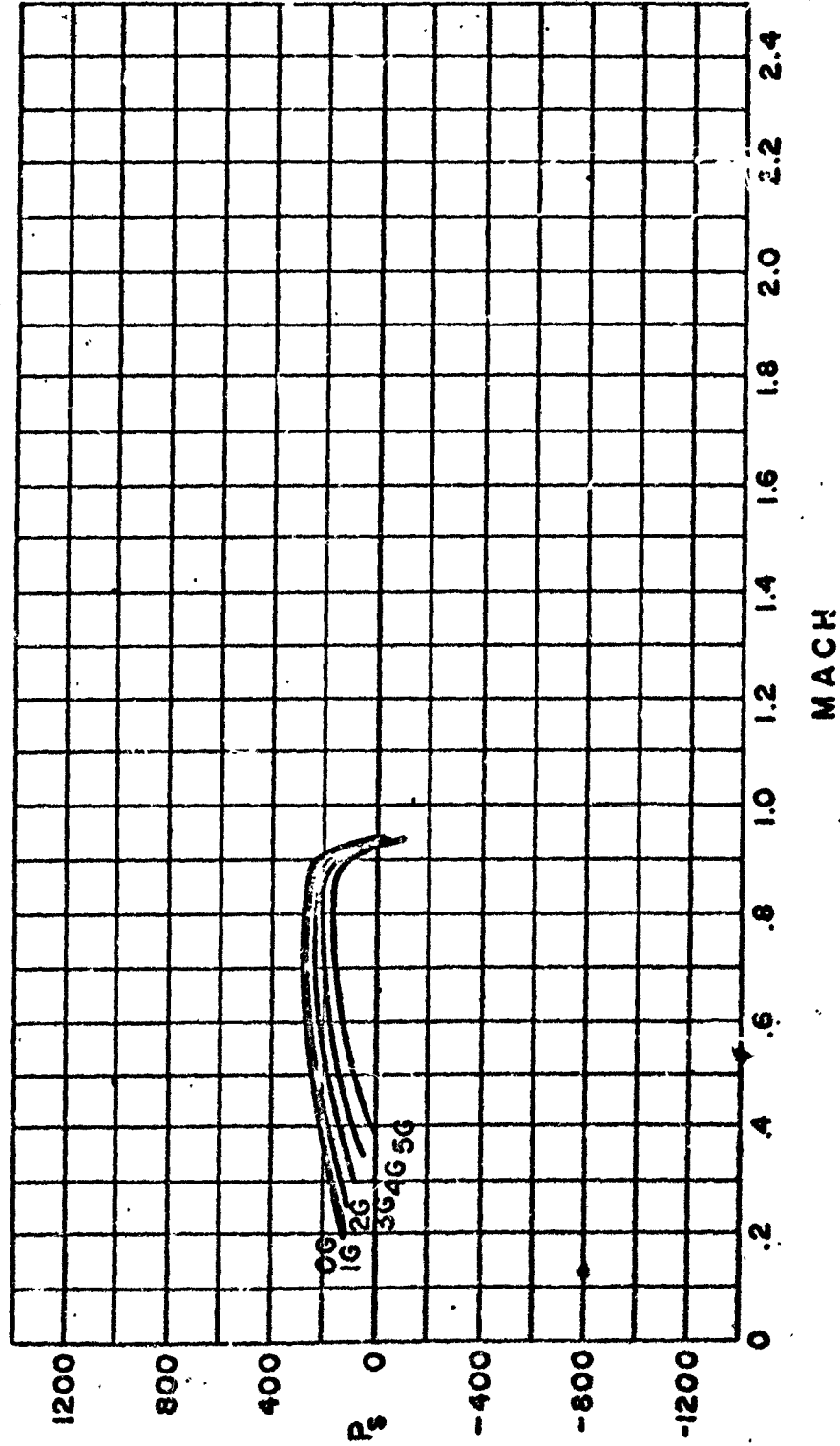


SECRET

SECRET

# MAXIMUM POWER - SEA LEVEL

MIG-17

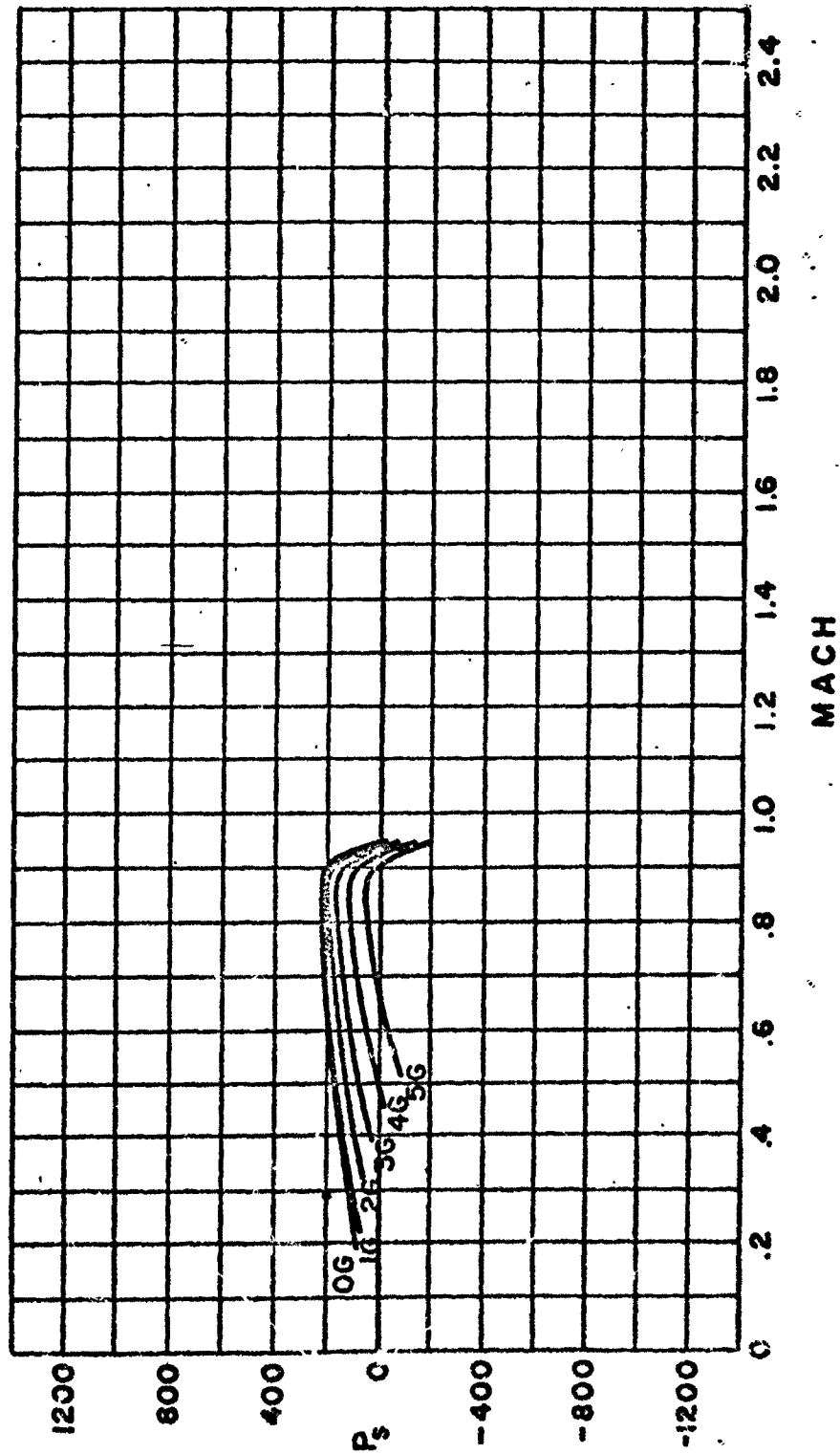


SECRET

SECRET

MAXIMUM POWER - 15,000'

MIG-17

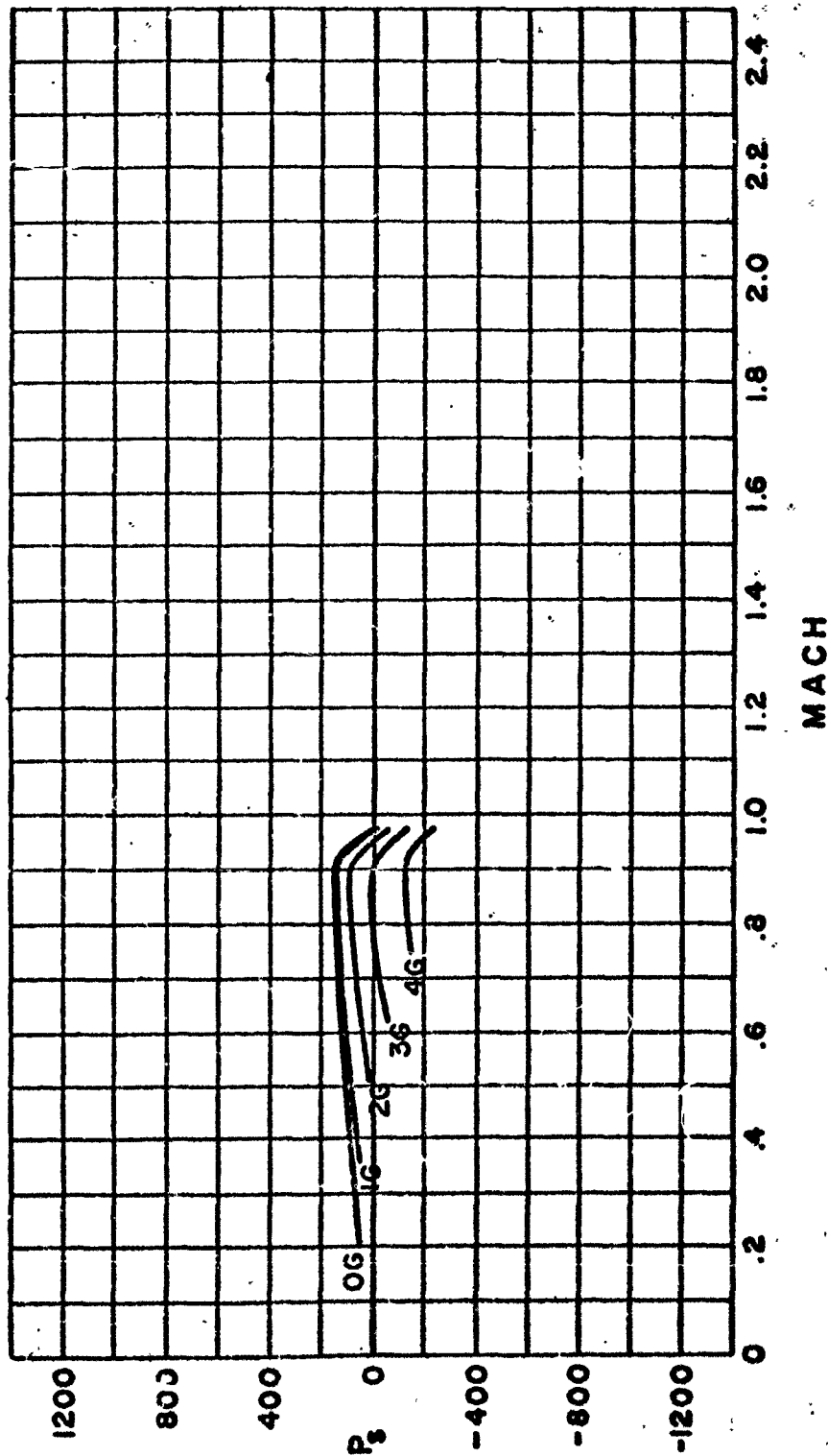


SECRET

SECRET

MAXIMUM POWER - 35,000'

MIG-17

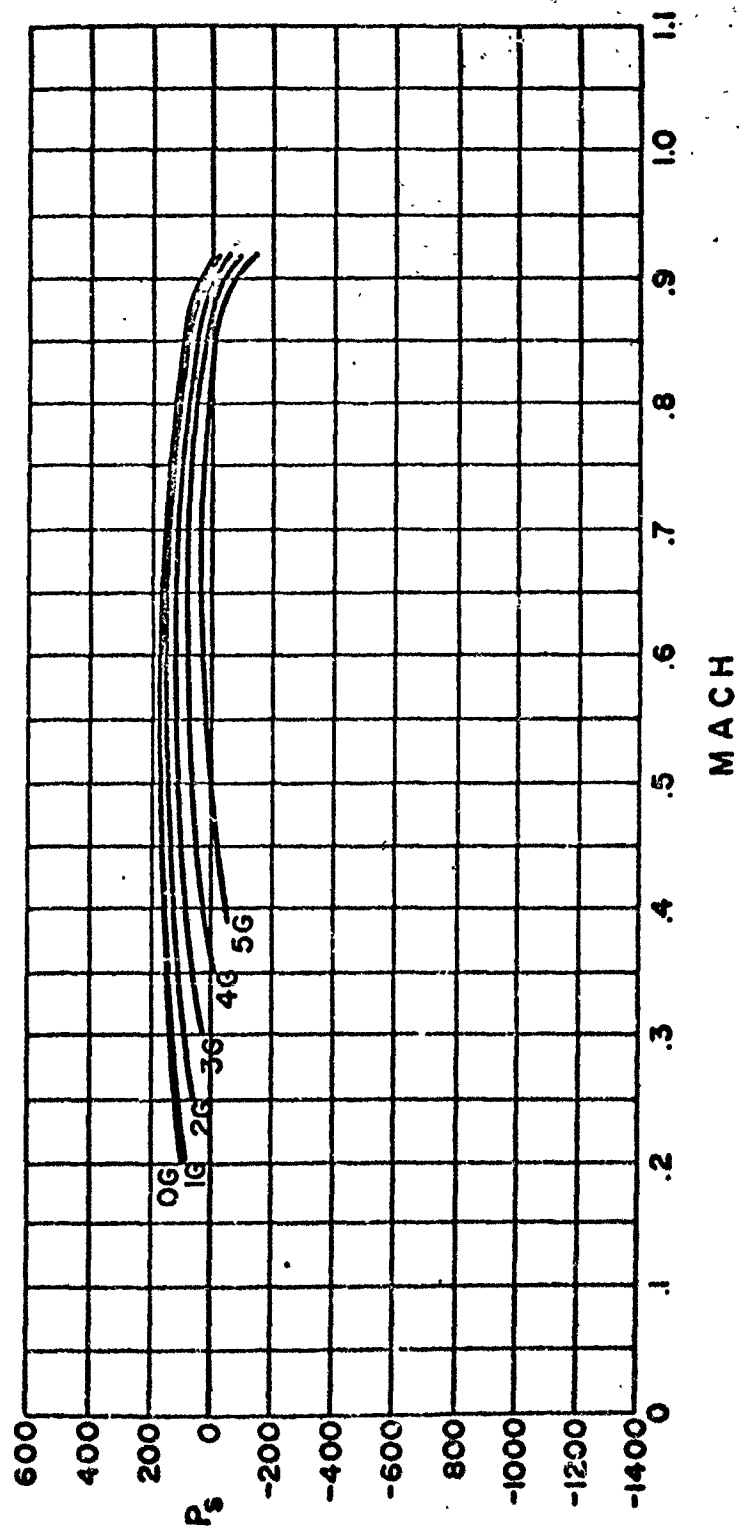


SECRET

SECRET

# MILITARY POWER - SEA LEVEL

MIG-17



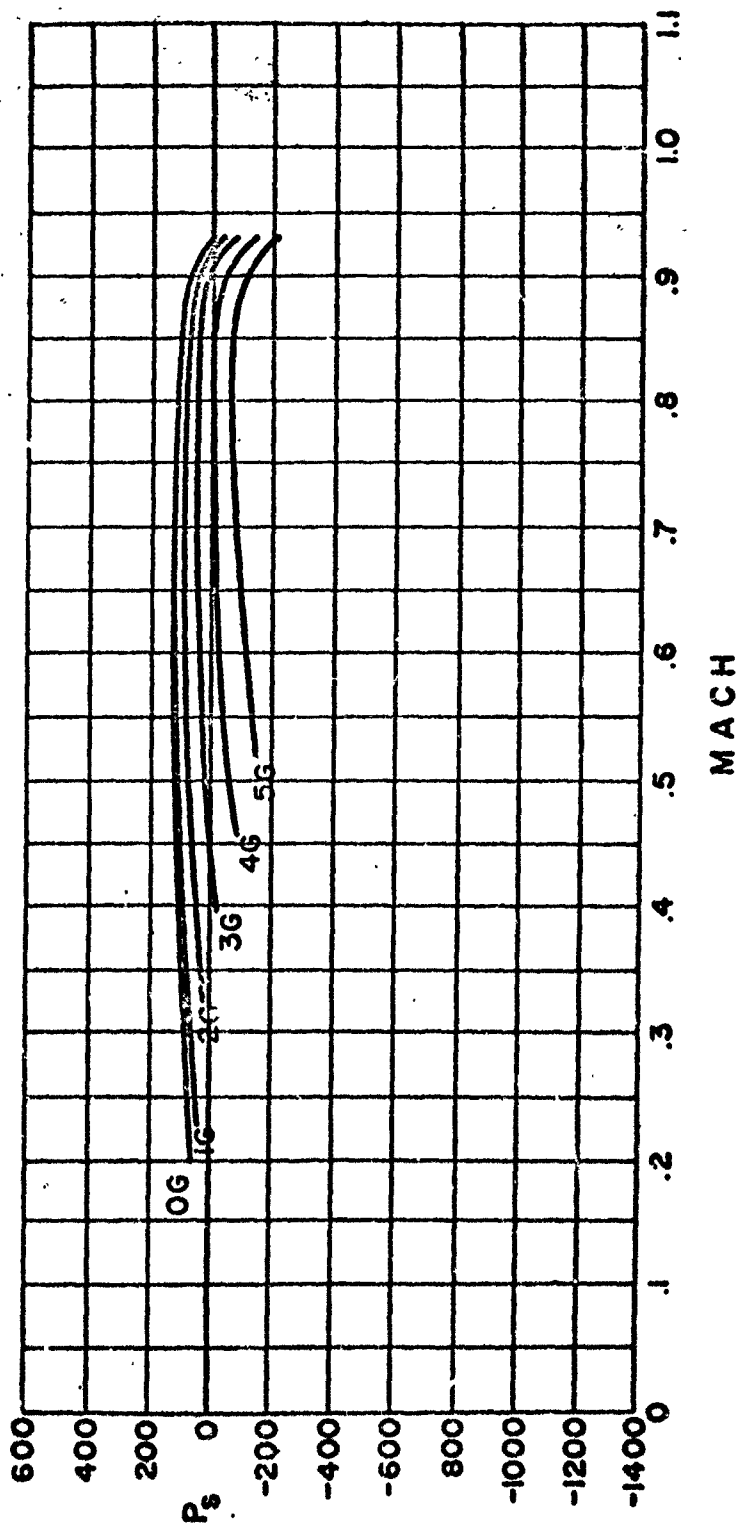
SECRET



SECRET

MILITARY POWER - 15,000'

MIG-17

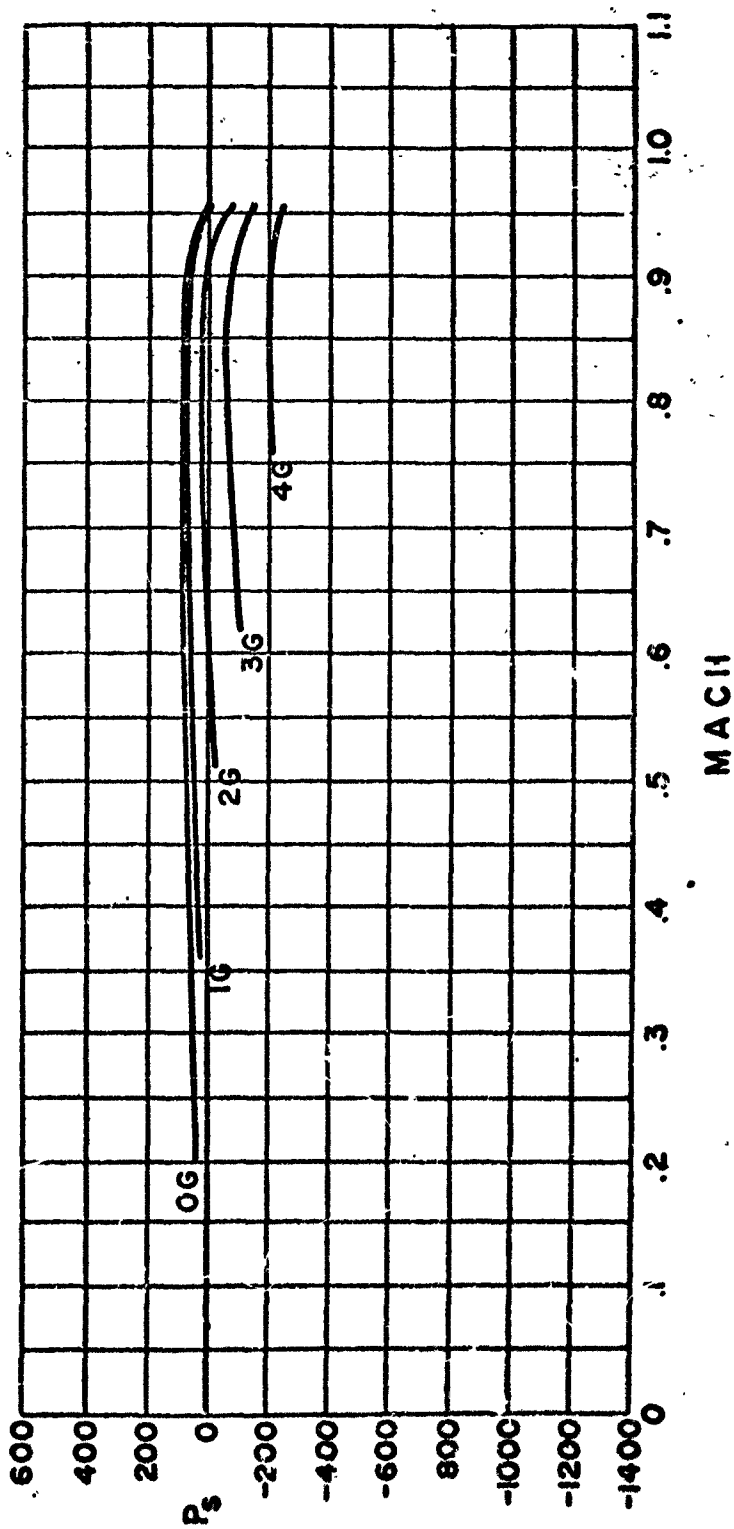


SECRET

SECRET

MILITARY POWER - 35,000'

MIG-17

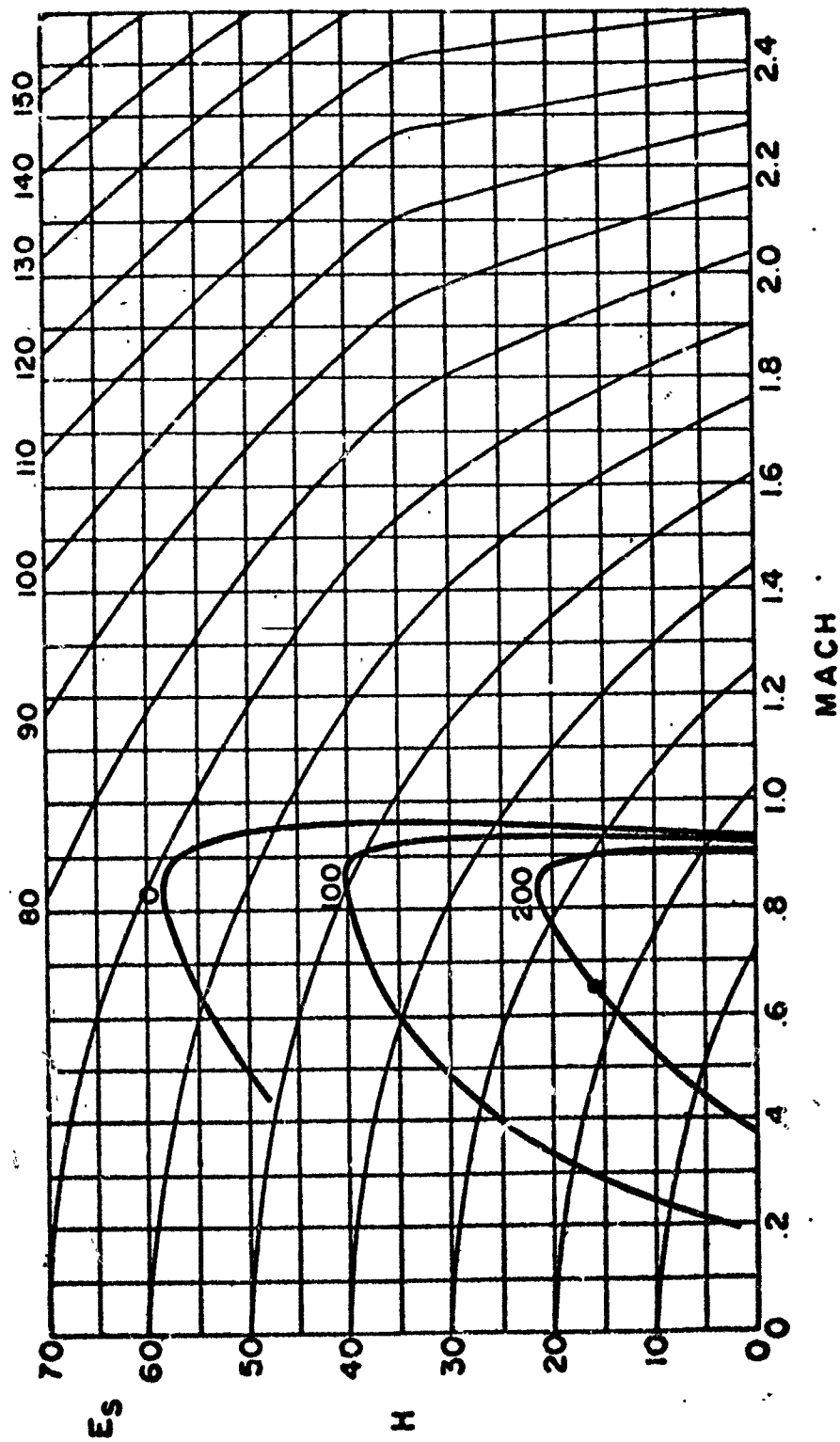


SECRET

SECRET

**ENERGY RATE  
MAXIMUM POWER 1G**

**MIG-17**

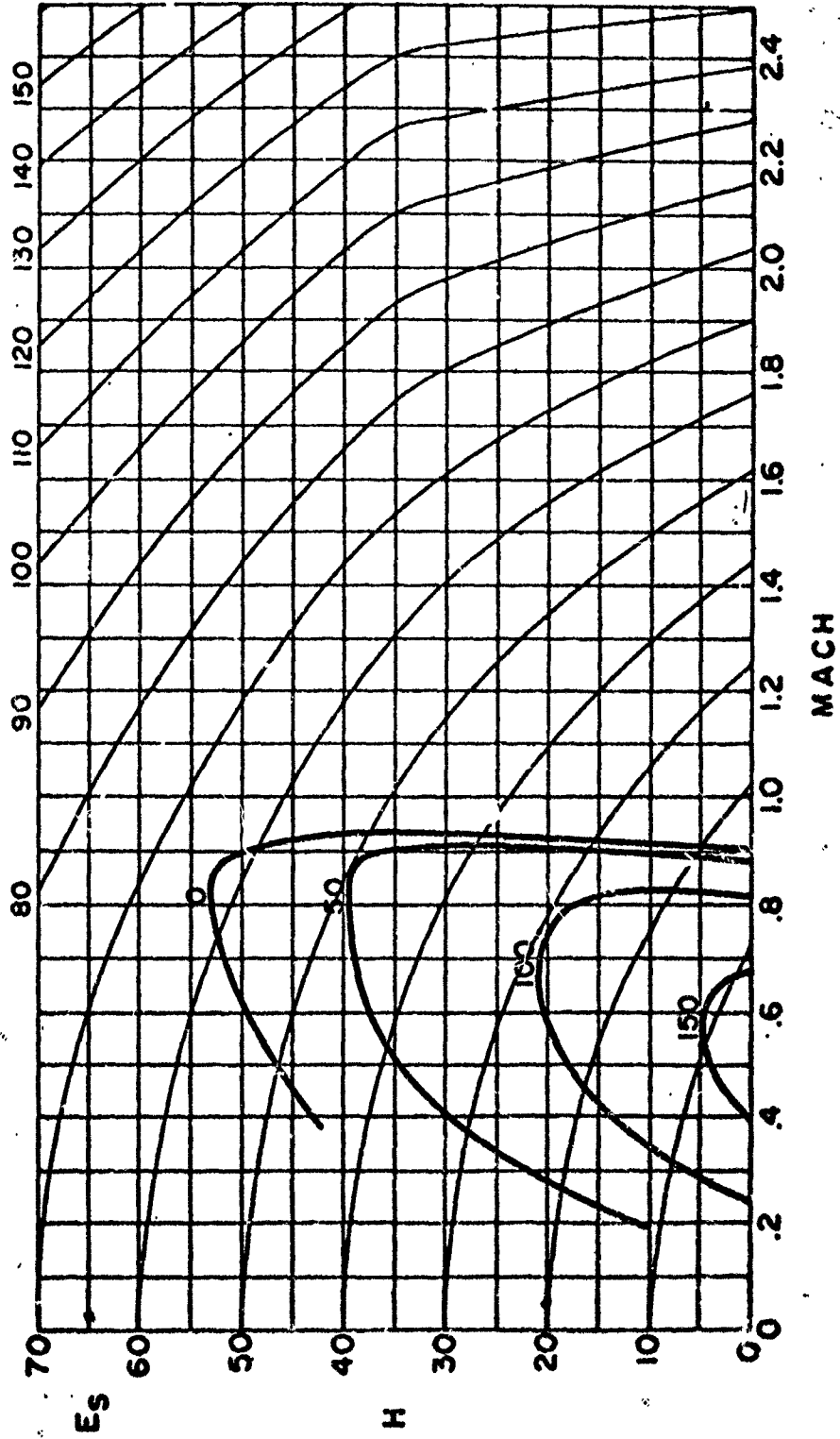


SECRET

SECRET

**ENERGY RATE  
MILITARY POWER · 1G**

**MIG-17**



SECRET

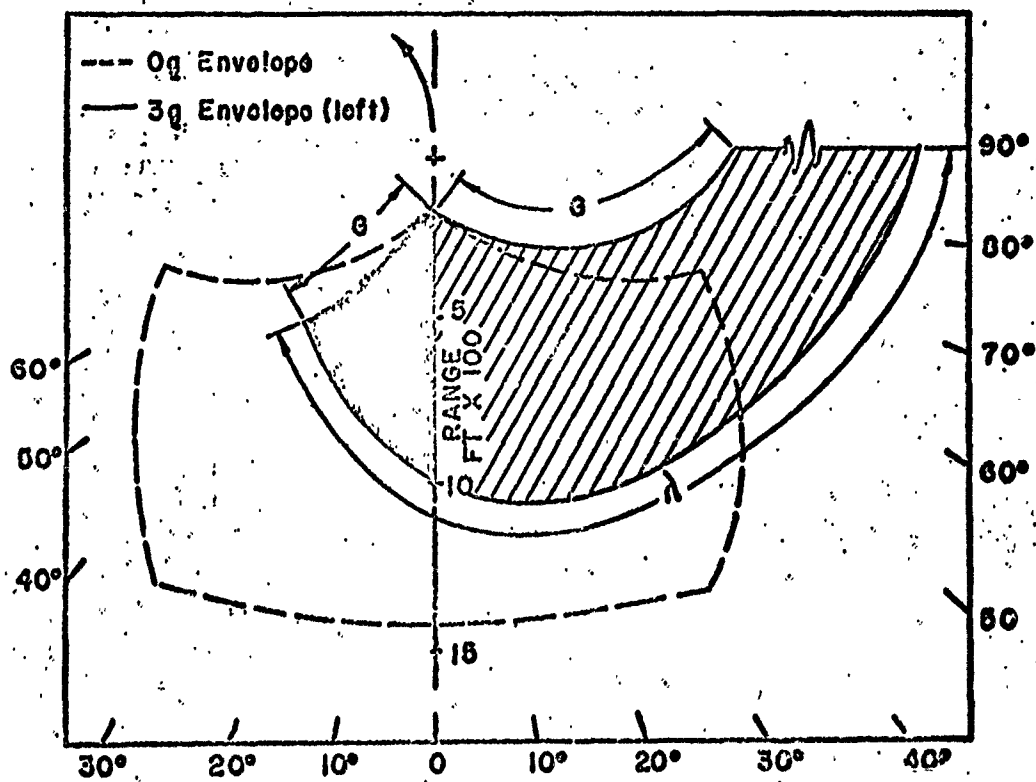
**UNCLASSIFIED**

**ANNEX H**

**AIM-9/B MANEUVERING ENVELOPES**

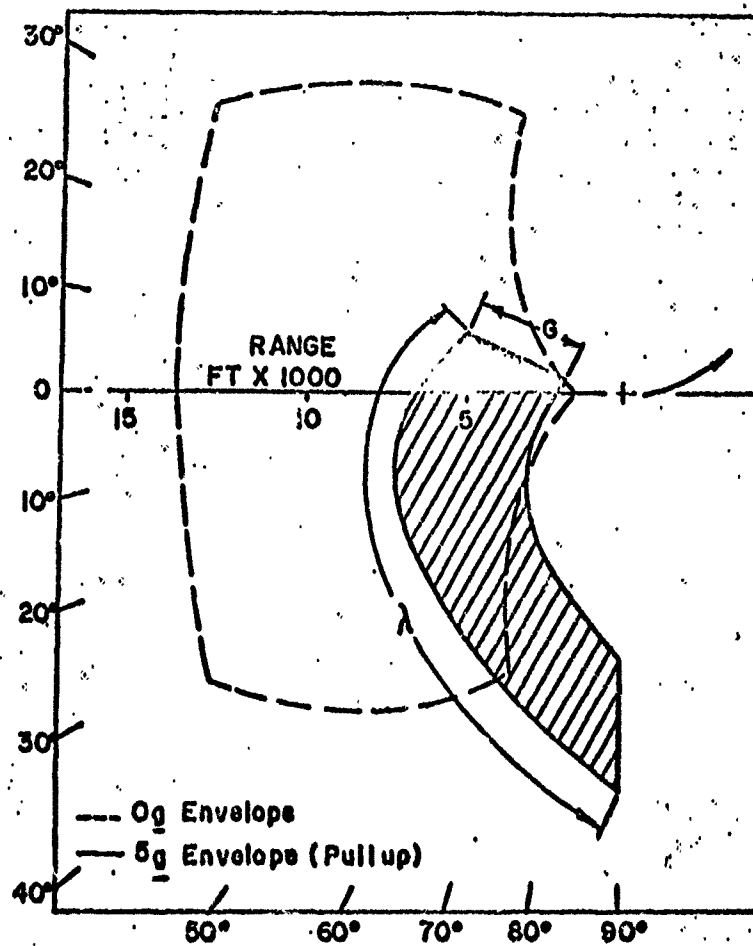
**UNCLASSIFIED**

SECRET



TGT - 1.0 MACH  
ATTACK - 1.0 MACH  
ALTITUDE - 35000'  
TGT MANEUVER - 3g LEFT TURN

SECRET



TGT - .9 MACH  
ATTACK - .9 MACH  
ALTITUDE - 35000  
TGT MANEUVER - 5g PULL UP

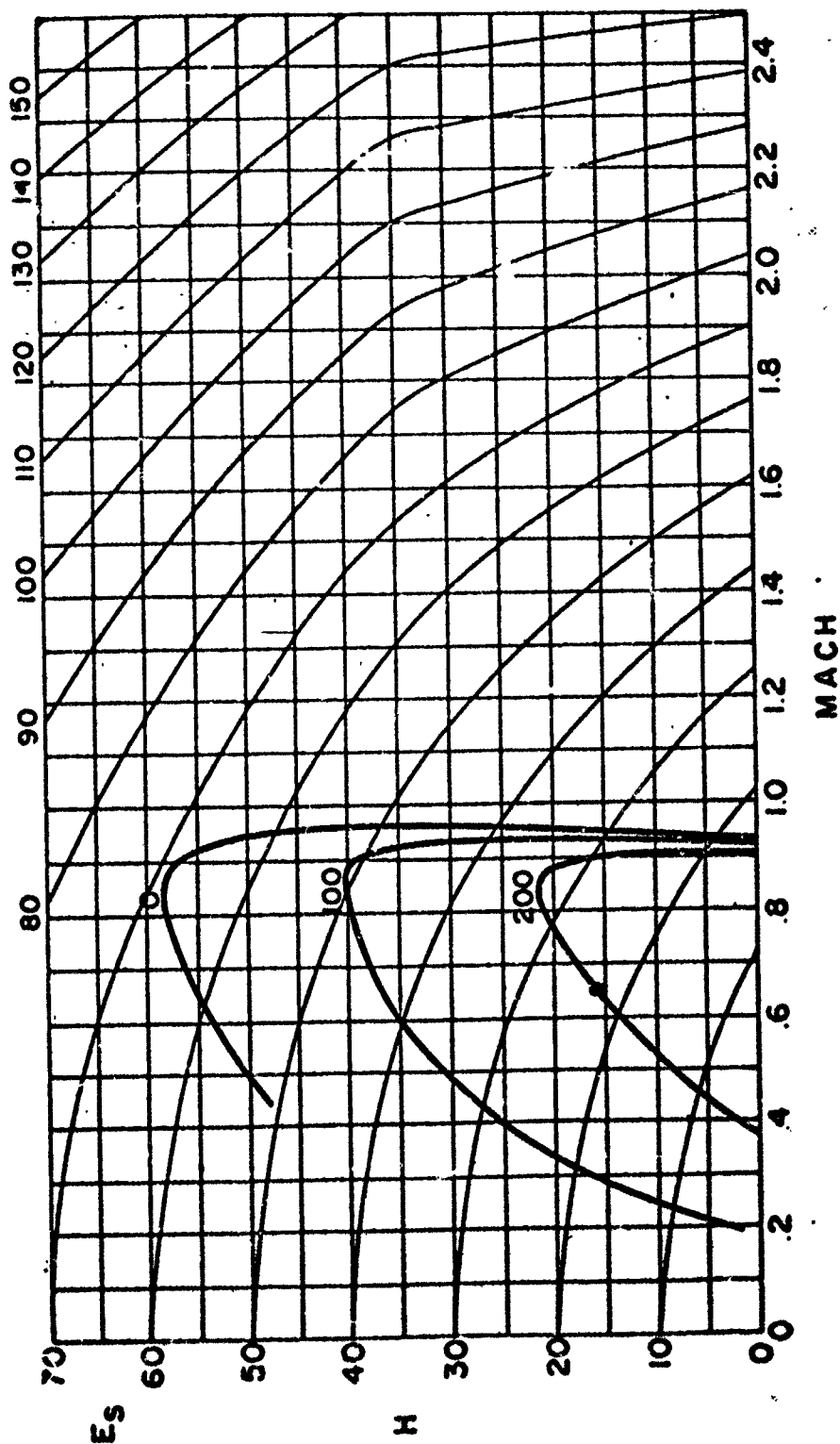
Figure 20

SECRET

SECRET

**ENERGY RATE  
MAXIMUM POWER 1G**

**MIG-17**



SECRET



(13)  
Distribution: 1 cy ea FZR Wg (except 479<sup>th</sup>  
which got sep)  
1 cy CEAG,  
1 cy Carl Mersch, Maryland ANG.

**SUPPLEMENTAL**

**INFORMATION**



DEPARTMENT OF THE AIR FORCE  
USAF WEAPONS SCHOOL (ACC)  
NELLIS AIR FORCE BASE, NEVADA

14 November 1995

MEMORANDUM FOR DTIC

FROM: USAF WS/DCO  
4325 Tyndall Ave  
Nellis AFB NV 89191-6075

ERRATA  
AD-372500

SUBJECT: Release of USAF Weapons School Publication

Publication titled, Final Report: TAC Mission EF 857 Air Combat Tactics Evaluation, AD 372 500 was declassified on 6 October 1995 and is cleared for public release. POC is 1t Lt Angelene Barton at DSN 682-4972.

*James D. Cantwell*

JAMES D. CANTWELL, Lt Col, USAF  
Deputy Commandant

ERRATA